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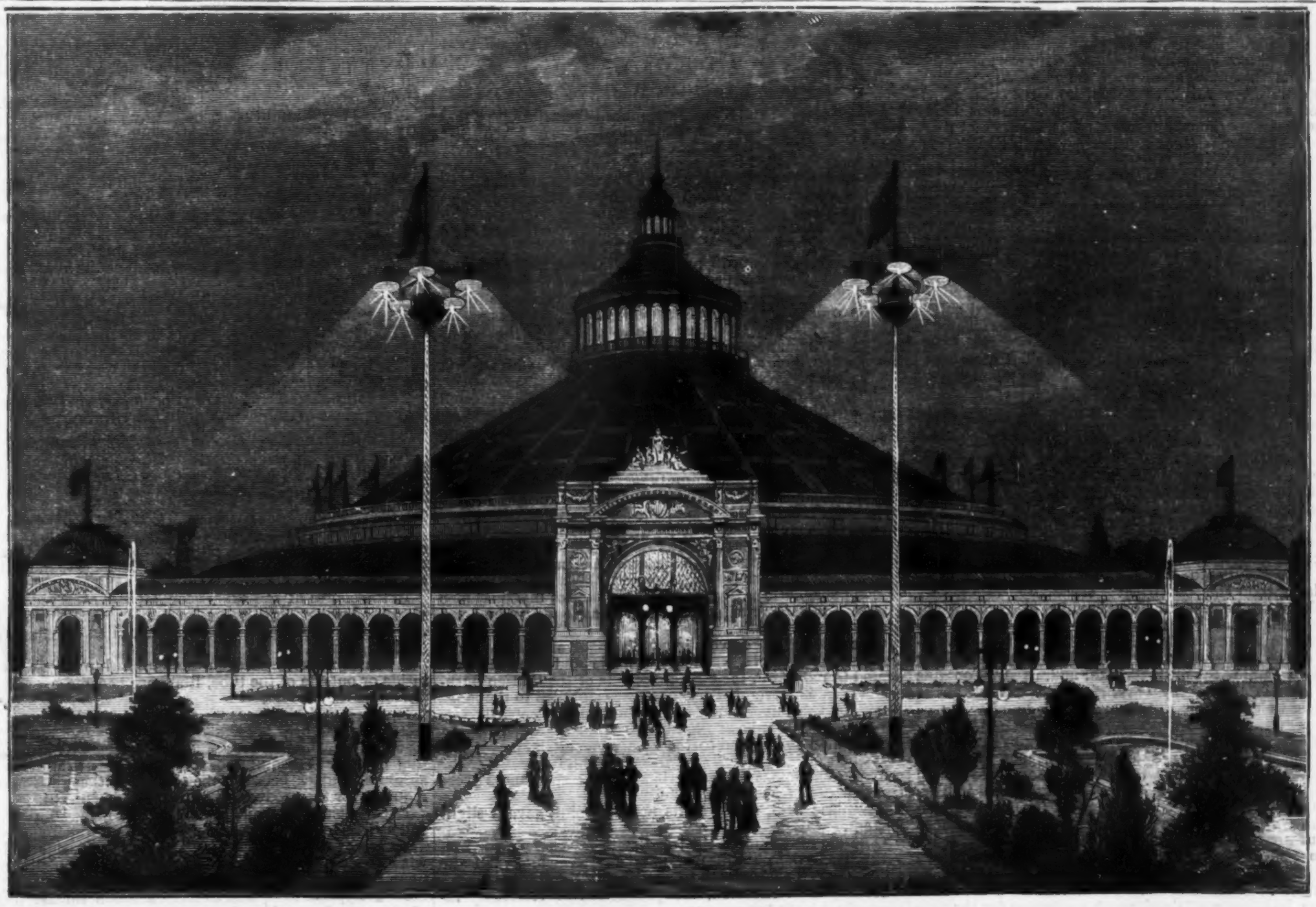


THE ELECTRICAL EXHIBITION, VIENNA.—INTERIOR AND EXTERIOR VIEWS OF THE BUILDING.

THE VIENNA EXHIBITION OF ELECTRICITY OF 1883.

The Exhibition of Electricity that opened at Vienna on the 16th of August, 1883, was very remarkable, very brilliant, and much admired by its numerous visitors. Although it was not as important as the Paris Exhibition of 1881, its success was very great and exceeded the hopes of its promoters.

It was in the rotunda—that grand remnant of the Universal Exhibition of 1873—that were united the scientific and industrial wonders from all parts of the globe. Austria, the United States, England, Germany, France, Belgium, Italy, Russia, Turkey, Denmark, Sweden, Portugal, Spain, and Switzerland sent their most interesting productions. A few nations were represented in every branch of electricity.

Among the most curious apparatus of the collection, we must especially mention the following: the radiophone for demonstrating the transmission of speech by means of light; Boudot's new apparatus for transmitting simultaneously six telegrams over the same wire at the rate of 9,000 words per hour; the Meyer apparatus, much improved and capable of sending 5,000 words per hour; several Hughes apparatus, two of them in combination with the Mandroux relay; a mirror apparatus, working as a duplex on the coast of Algiers; and a splendid series of telegraphic apparatus dating from the first experiments thereon up to the present time, and forming a complete history of the successive inventions in telegraphy.

Mr. Preece, the eminent English electrician, exhibited an extremely remarkable telephone that overcomes most of the difficulties in the way of a rapid communication between subscribers in the same city. With these new apparatus, when the subscriber goes out he notifies the central office of the fact by the simple maneuver of a small winch. When the conversation is finished, it is only necessary to put the receiving apparatus in their proper place in order to notify the central office, etc. These advantages are obtained by the introduction of a pile which constantly charges the telephone line.

The Railway Company of the East exhibited a series of apparatus invented by Mr. Napoli, and several ingenious arrangements of Mr. Dumont for telegraph service at stations.

Siemens and Halske's block systems were very remarkable, and the application of them is at present so extended in Germany and many other countries that the minor inconveniences that they at first presented have completely disappeared. In the Belgian section there was quite an original invention, consisting of a gun which had no percussion mechanism, and the cartridges of which had no capsules. The powder in this is ignited electrically by means of a small accumulator that the hunter carries in his waistcoat pocket. According to the inventor, Mr. Pieper, the accumulator contains sufficient electricity to permit 10,000 shots to be made before having to recharge it. Accidents in hunting are thus suppressed, the range of the weapon is rendered greater, etc. Despite this hunters are so accustomed to routine that they will long continue to employ the ordinary gun, and, as Mr. Fontaine frankly says in the *Revue Industrielle*, we cannot blame them, since we omitted to say that, in order to make use of the Pieper gun, it is necessary to put on a garment provided with a wire gauze device, and also to put on gloves that are likewise metallized. To put on gloves to shoot at a rabbit is indeed doing the latter too much honor. We would also note the following: the objects manufactured in Turkey; the apparatus exhibited by Denmark for firing submarine mines; Doctor Wreden's phonophores; the specimens and pictures presented by Mr. Gaston Plante to illustrate his labors in electricity; the small demonstration machines of Mr. A. Gerard; and the silicious bronze wires exhibited by Mr. L. Weiller, of Angouleme. The northwest court of the exhibition building contained much apparatus for the production of the power necessary in the different departments. The chimney was truly monumental, its section being 9 meters, and its height 28½ meters. It was divided into four equal parts by a cross-shaped internal partition.

The total heating surface of the generators was 1,660 meters, and they were capable of producing at least 20,000 kilogrammeters of steam per hour, and did, in fact, give 100,000 kilogrammeters per day with a mean consumption of 26 tons of coal.

The total power put at the disposal of the electricians may be distributed thus:

19 stationary steam engines	1,233 H.P.
12 locomotives	200 "
9 gas motors	80 "
Total	1,513 "

The motive power was utilized for setting in motion 160 dynamo-electric machines, among which we may cite the following:

A Ferranti machine, which produced alternating currents, and which supplied, with an induced disk that weighed not over 10 kilos, 400 incandescent lamps.

A Siemens 40 H.P. machine (with double winding on the electros), which actuated the tramway engines.

A 4 pole Gramme machine, which actuated the Dumont pump that lifted the water for the central cascade.

As at Paris, the lamps were divided into two categories—those that were designed for the lighting of workshops and other large places, and that were based upon the principle of the voltaic arc, and those used in theaters, etc., and that were based upon incandescence.

The motive power was distributed as follows:

400 arc lamps, absorbing on an average ½ H.P	600 H.P.
2,500 incandescent lamps of 0·16 H.P. on an average	400 "
Various purposes, such as electric carriage and electro-metallurgy	100 "
Cascade pump	50 "
Electric tramway	50 "
Light projectors	50 "
Driving shafts and general shafting	200 "
Total	1,450 "

The lighting, properly so called, absorbed, then, 1,000 H.P., in round numbers, for the production of a light of 45,000 Carcel burners, or 45 burners per horse power, without taking into account the work absorbed by the shafting.

The total surface lighted was approximately 25,000 square meters, so that the light per square meter was about 1·8 Carcel burners. Under normal conditions a good illumination absorbs one burner per 3 square meters. There was, then, actually, in the rotunda and its annexes, proportionally 5½ times more light than in the best lighted stores or cafés.

At Paris, in 1881, the total intensity was 50,000 Carcel burners, and the motive power expended (including that absorbed by the shaftings) reached 1,350 horses, corresponding to 37 Carcel burners per horse power. The total surface lighted was 29,300 square meters. Each square meter received, then, on an average, a light of 1·7 Carcel burners—this being sensibly the same mean intensity as at Vienna.

In sum, the Vienna Exhibition offered, as regards its lighting, the most beautiful spectacle that has ever thus far been presented for our admiration, and nowhere else has so great a quantity of light been hitherto concentrated at any one point.

The theatrical representations and the telephone auditions were, in addition, well arranged in the rotunda, and it was specially due to these two artistic manifestations that the public best appreciated the modern discoveries that have been made in the domain of electricity.—*La Nature.*

ON A NEW METHOD OF GENERATING ELECTRICITY.*

By J. A. Kendall, F.I.C., F.C.S.

In 1863 Deville and Troost announced their discovery that certain metals were permeable by hydrogen at a red heat. This discovery, as is well known, was verified by Graham, who made extended researches on the subject.

About three years ago it occurred to the author that a red hot platinum plate, through which hydrogen was passing, might be made to serve as an element of a galvanic combination, and early in 1881 some experiments were tried with this object.

These were continued from time to time up to the present, and in this paper it is proposed to give some account of the experiments and their results. The subject appears to the author to require much more extended researches in several directions than he has been able to make, but it is hoped that by giving an account of the researches hitherto made, the points which require further investigation will suggest themselves to physicists and chemists.

In the earlier experiments the author constructed small tubes of platinum foil. These were sealed up at one end by the oxyhydrogen blowpipe, and to the open ends glass tubes were fused. Platinum conducting wires were fastened to the tubes. By means of the glass tubes gases could be conveyed to the interior of the platinum tubes.

A platinum crucible was used at the other element of the cell; it had a platinum conducting wire attached, and was supported over a Bunsen burner. A small platinum foil tube was then held in the center of the crucible, and the cell was completed by putting the transmitting medium into the crucible. After unsuccessful trials with alkaline nitrates, etc., glacial phosphoric acid was selected. Some of this substance was put into the crucible and fused so as to nearly immerse the platinum foil tube.

On connecting the two wires with a galvanometer no deflection was observed when the crucible and contents were heated to redness in the oxidizing flame of the Bunsen burner. When, however, hydrogen gas was supplied to the inner platinum tube, an immediate production of electricity was perceived. The tube of platinum foil containing hydrogen was seen to correspond to the zinc element in an ordinary galvanic cell.

This experiment being verified, other substances were tried instead of phosphoric acid.

Sulphuric acid, nearly at its boiling point, gave a slight current.

Chloride of sodium in the fused state gave a very good result. Then the chlorides of potassium, calcium, and the alkaline earth metals were tried with similar results.

As might be expected, the production of electricity increased with the temperature.

It was, however, soon found that the production of the current was stopped if the flame of the Bunsen burner did not insure perfect combustion on the exterior of the platinum crucible.

Experiments showed that if a reducing flame was applied to the crucible while the small tube contained air, then a current of electricity in the reverse direction was obtained.

Tubes of palladium foil substituted for the platinum tubes gave similar results.*

After a number of trials with tubes of platinum foil, an apparatus was constructed of two platinum tubes closed at one end.

The inner tube was 4 inches long and ⅜ inch internal diameter, while the outer tube was 3⅝ inches long and ⅝ inside diameter. The thickness of metal was $\frac{1}{100}$ inch in both tubes.

The two tubes when used for these experiments were arranged upright in a small Fletcher's gas furnace, the inner tube being supported at any desired height in the center of the larger tube and connected with a supply of hydrogen.

Numerous experiments were made with this apparatus. The temperature could be easily regulated from a dull red heat to a white heat, and various saline substances could be tried as media.

The fused sulphates, carbonates, and nitrates were found to be unsuitable for the production of the current. The results obtained with fused chlorides, etc., showed that the hydrogen not only passed through the metal of the inner tube, but also through the fused saline medium and then through the outer platinum tube.

In recent experiments with this apparatus, it appears that when a good transmitting substance is used between the tubes, and when about 3·3 square inches of the inner tube are in contact with the medium, the amount of hydrogen gas which passes through the metal at a nearly white heat is about 0·7 cub. centim. per minute. This volume, of course, refers to hydrogen at ordinary temperatures.

The use of this apparatus led to the discovery of a large number of substances which would serve as media by allowing the transmission of hydrogen.

The list of saline bodies was extended to the bromides, iodides, and fluorides of the alkaline and earth metals, but the most important discovery in this direction was that vitreous bodies, such as glass, and even vitrified bodies, as porcelain and earthenware, acted as media when at a red heat. Attention was then directed to the use of vitreous media for several reasons.

In experiments with fused saline bodies, the use of common metals was precluded owing to their being corroded by fused salts; and although iron is known to be permeable to hydrogen at a red heat, yet its oxidizable qualities prevented any satisfactorily results being obtained when it was substituted for platinum.

However, when vitreous matters were used instead of fused salts, it became possible to use other metals for these experiments.

A number of trials were made by taking tubes of fusible soda glass. A small tube of the metal to be tested was then placed inside the glass, and while passing a slight current of coal gas to prevent oxidation of the metal, the glass was carefully fused on to the metal. The external surface of the glass, while soft, was then coated with thin platinum foil or with other metals.

On connecting the inner and outer coatings with a galvanometer, passing hydrogen through the tube, and then heating it to redness, the usual current of electricity was produced.

The quantity of electricity generated both with these cells and with the platinum tubes was in proportion to the surface heated.

The most powerful effects were obtained when the metallic coating was in the pulverulent form. Spongy platinum, for example, when made to adhere closely to the glass gave a strong current with hydrogen.

When using thin metallic plates in the interior of the tubes, it was found necessary to employ very thin platinum foil on the exterior, as the hydrogen otherwise accumulated to some extent on the inner plate, thus spoiling the cell.

A good result might often be got by painting the external surface of the glass with an alcoholic solution of platinic chloride, and then igniting. By this means a very thin film of metallic platinum was left on the glass, and by means of a spiral of platinum wire also put round the glass, sufficient conduction was obtained.

As glass exerts only a slight action on metallic iron at a red heat, thin sheet iron ($\frac{1}{100}$ inch) was used in numerous experiments, but this does not make a perfect arrangement when glass containing alkali is used, as the alkali metal is liberated by the iron at a very strong heat.

A number of metals were tried either in the form of sheet or as a powdery deposit.

This latter form might frequently be obtained by coating the interior of the glass tube with the oxide of the metal to be tried, and then reducing the metal by hydrogen or coal gas upon the surface of the glass.

The following metals were tried and found to transmit hydrogen and cause the production of electricity:

Platinum,	Molybdenum,
Palladium,	Copper,
Gold,	Silver.
Iron,	
Nickel,	

The relative transmitting powers were not, however, ascertained. There can be little doubt that the property of transmitting hydrogen at a red heat belongs to most, if not all, metallic bodies.

In the course of the experiments it was observed that the glass used was practically a non-conductor of electricity from one or two galvanic cells when it was heated to redness in an oxidizing flame.

When, however, hydrogen was supplied to the glass either inside or outside of the tube, it at once became a good conductor of the current.

It was found necessary to avoid using glass containing metallic oxides reducible by hydrogen, as these oxides, by reacting upon the hydrogen on the surface of the transmitting plate, cause frothing of the glass, thus destroying that absolute contact between the metal and the glass which is required for the production of the electric current.

Experiments were made with tubes of Berlin porcelain, and satisfactory results were obtained. It was found convenient to cover the surface of the tube, both inside and out, with melted glass, and then to carefully lay platinum foil upon the glass, so as to get as perfect an adherence as possible. It appears to be best to have a much thicker metallic plate on the inner side of the cell than on the outside. The author has not determined the most advantageous conditions precisely as yet. Cells were also constructed of clay, containing a percentage of glass, porcelain of various kinds, etc.

The amount of hydrogen transmitted in a given time through the arrangement described varies greatly according to the nature of the medium and the nature of the metallic layer.

With pulverulent metals and a medium of soft glass, the rate of transmission of hydrogen may be as high as 0·6 cub. centim. per square inch per minute at a full red heat. With Berlin porcelain tubes, however, the transmission does not usually exceed 0·2 cub. centim. per square inch per minute, even at a white heat, while at a red heat the rate is much lower. With platinum tubes of $\frac{1}{100}$ inch thick the transmission may be from 0·1 cub. centim. to 0·2 cub. centim. per square inch, according to the temperature.

The electromotive force of the new cells varies according to the media used, and this subject will of course require further investigation. It was found, however, that the platinum tube cell gave, with borate of lime at a nearly white heat, an electromotive force=0·36 of a Daniell, while a cell constructed of Berlin porcelain tube $\frac{1}{8}$ inch thick gave an electromotive force=0·7 of a Daniell when worked at a nearly white heat.

Although many gaseous mixtures containing free hydrogen will serve to produce the electrical reactions, yet experiments with carbon monoxide have given no similar result in conjunction either with iron or platinum plates.

Before describing further researches which the author has made on the subject of electrical currents produced by hydrogen, it may be well to mention that the galvanometer generally used in the experiments yet to be described, as well as in the former experiments with metal tubes, etc., is one adapted for rather strong currents, and it has very slight resistance. It has been graduated by means of a voltameter.

As these experiments must be regarded more as qualitative than quantitative, it will perhaps be sufficient to give four points of deflection with the corresponding liberation of hydrogen in a voltameter.

Deflection of galvanometer.	Liberation of hydrogen per minute.
10°	0·07 c. c.
20	0·21 "
30	0·60 "
40	1·35 "

The above figures also show, in a roughly approximate way, the amount of hydrogen which must be supplied to a cell of the new construction in order to give the deflection indicated.

In continuing his researches the author has found that strongly heated hydrogen may give rise to electrical currents under a variety of circumstances.

* A paper read before the Royal Society, Jan. 17, 1884.—*Chem. News.*

Small cells were made by nearly covering short wires or rods of metal with melted glass. The glass was then covered with platinum foil, and the two metals were connected by wires with the galvanometer. On heating a cell of this construction in an oxidizing flame an electrical current was almost invariably produced, due to the withdrawal of hydrogen from the inner wire or rod. When the current diminished in force, a reducing flame containing free hydrogen was applied to the cell. This immediately caused an energetic reverse current, accompanied by the reabsorption of hydrogen by the inner metal. Then with an oxidizing flame the original effect could be produced. These results were obtained with wires of platinum, nickel, iron, and copper. In working with cells of this description made with iron rod, it was found that a current of electricity of long duration could be produced by the oxidizing flame. This result appears to be due to the continuous absorption of hydrogen liberated from aqueous vapor by that portion of the iron which was not covered by glass.

When the entire surface of the iron was covered by glass (with the exception of the conducting wire, which was away from the heat), then the deflection of the galvanometer gradually came to zero when the cell was heated in an oxidizing flame.

Recently experiments have been made with a differently arranged apparatus, as follows:

A platinum tube, 5¼ inches long and 1 inch diameter, was set upright in a Fletcher's gas furnace and nearly filled with a fusible glass composed of the diborates of lime and magnesia. This apparatus being heated to bright redness, a plate of platinum, 2 inches long and 0·6 inch wide, suspended by a platinum wire, was immersed in the fluid glass. The platinum tube and the plate being connected with the galvanometer, the phenomena of alternate electric currents could be produced with great facility by altering the nature of the flame in the furnace. When the platinum tube was surrounded with a visible pale flame, there was an electrical current from the tube to the plate until the plate was apparently saturated with hydrogen. When more air was supplied to the furnace, so as to cause more perfect combustion, the needle of the galvanometer was violently reversed. The deflection produced on the galvanometer by either the "normal" or "reverse" current was at first 18° to 20°, and it fell to nearly zero within ten or fifteen minutes.

These effects could of course be repeated as often as required.

It appears quite plain that the hydrogen in flames has a powerful molecular or atomic action.

If glass be fused in a large platinum crucible heated by flame as in a Fletcher's furnace, bubbles of hydrogen may be observed forming and rising from the sides of the crucible, especially at the hottest parts.

If a platinum tube like that used for the experiments with the suspended plate be somewhat cooled while nearly full of melted glass, so that the glass becomes very viscous, then by applying a flame containing free hydrogen to any spot on the lower part of the tube the latter may be easily burst by the bubble of hydrogen which is formed on the inside of the tube.

Experiments have also been tried in which the hydrogen coming through a cell was removed by means of a Sprengel pump. One experiment may be described: A platinum tube 2¾ inches long and ⅜ inch diameter, closed at one end, was soldered to a strong iron tube and fixed vertically. The platinum tube was immersed for 2¼ inches in fused glass contained in a platinum cell. This latter was 2⅝ inches deep and 1 inch diameter.

The two platinum tubes were connected by platinum wires with the galvanometer, and the iron tube was connected with a Sprengel pump.

The cell being heated to bright redness in an oxidizing flame, a good vacuum was produced by the Sprengel pump. Then, while no bubbles of gas came down the fall tube of the pump, the galvanometer showed no deflection.

The cell was then heated by a reducing flame. The galvanometer soon gave a steady deflection of 15°, and bubbles of hydrogen came down the fall tube of the pump. The experiment was continued for half an hour, and during fifteen minutes the hydrogen coming down the fall tube was collected. It measured 1·33 cub. centims.

From occasional experiments with several vitreous mixtures the conclusion formerly arrived at by the author regarding their electric conductivity is confirmed, viz.: that these fused vitreous matters do not conduct electricity of low tension unless hydrogen be present. When working with large cells it is, of course, difficult to avoid the presence of hydrogen if the cell be heated by flame.

It appeared desirable to try whether any hydrogen could be made to pass through the walls of a porcelain tube either under the influence of oxygen or by means of a vacuum.

A glazed Berlin porcelain tube 20 inches long and ½ inch diameter was sealed up at one end and connected with a Sprengel pump. The closed end of the tube exposing a surface of 4 square inches was heated to whiteness in the gas furnace, but no hydrogen could be drawn by the Sprengel pump when the porcelain tube was heated in a reducing flame.

After this the porcelain tube was filled with hydrogen, and the same part as before was heated in an oxidizing flame, but no loss of hydrogen from the tube could be perceived during half an hour.

Somewhat similar experiments have also been made with glass tubes and negative results.

The author has also made a few experiments to ascertain the influence of a voltaic current in increasing or diminishing the flow of hydrogen through the medium, but so much depends upon the structure of the metallic surfaces in contact with the medium and their relative sizes, as well as upon the electromotive force, etc., of the battery used, that this subject would probably require somewhat elaborate researches.

The author, however, hopes to make further investigations into the nature of the movements of hydrogen produced in vitreous matters and metals.

ACCUMULATORS FOR TELEGRAPHIC WORKS.

AT the central telegraph office at Strassburg, in Alsace, several interesting experiments with accumulators are in progress, which show thus early that their use in telegraph stations offers many advantages.

The first experiments were made with five accumulators of the Schulze system, which took the place of 20 Meidinger cells connected in two series of ten each. The battery operated six circuits and under these conditions the electro-motive force remained constant for 10 days. The accumulators were charged for about 4 hours with a current of 4 amperes, which was done in a building distant about 600 m. from the telegraph station. The cells used were comparatively small, being 13 cm. square by 24 cm. high, and weighed about 10 kg.

The advantages of using accumulators for the purpose mentioned are obvious. Among them we may cite the saving in room, the facility of inspection, and the cheap and simple maintenance. The first cost hardly exceeds that of the Meidinger cells now employed, and as regards the durability of the accumulators, a depreciation of 10% per annum would be amply sufficient, since trials have shown that the crumbling of the lead plates was comparatively insignificant after 300 charges and discharges.—*Ztsch. d. Elek. Ver.*

THE FIRST ELECTRIC TELEGRAPH.

THE idea of the practical application of the electric telegraph to the transmission of messages, says a writer in *Engineering*, was first suggested by an anonymous correspondent of the *Scots Magazine*, in a letter dated Renfrew, February 1, 1753, signed C. M., and entitled "An Expeditious Method of Conveying Intelligence."

After very considerable trouble, Sir David Brewster identified the writer as Charles Morrison, a native of Greenock, who was bred a surgeon, and experimented so largely in science that he was regarded in Renfrew as a wizard, and eventually found it convenient to leave that town and settle in Virginia, where he died. Mr. Morrison sent an account of his experiments to Sir Hans Sloane, the President of the Royal Society, in addition to publishing them anonymously, as stated above.

The letter set forth a scheme by which a number of wires, equal to the letters of the alphabet, should be extended horizontally, parallel to one another, and about one inch apart, between two places. At every twenty yards they were to be carried on glass supports, and at each end they were to project six inches beyond the last support, and have sufficient strength and elasticity to recover their situation after having been brought into contact with an electric gun-barrel placed at right angles to their length, about an inch below them. Close by the last supporting glass a ball was to be suspended from each wire, and at about a sixth or an eighth of an inch below the balls the letters of the alphabet were to be placed on bits of paper, or any substance light enough to rise to the electrified ball, and so continued that each might resume its proper place when dropped. With an apparatus thus constructed the conversation with the distant end of the wires was carried on by depressing successively the ends of the wires corresponding to the letters of the words, until they made contact with the electric gun-barrel, when immediately the same characters would rise to the electrified balls at the far station. Another method consisted in the substitution of bells in place of the letters: these were sounded by the electric spark breaking against them. According to another plan, the wires could be kept constantly charged and the signals sent by discharging them. Mr. Morrison's experiments did not extend over circuits longer than forty yards, but he had every confidence that the range of action could be greatly lengthened if due care were given to the insulation of the wires.—*Electrical Review.*

ATMOSPHERIC ELECTRICITY.

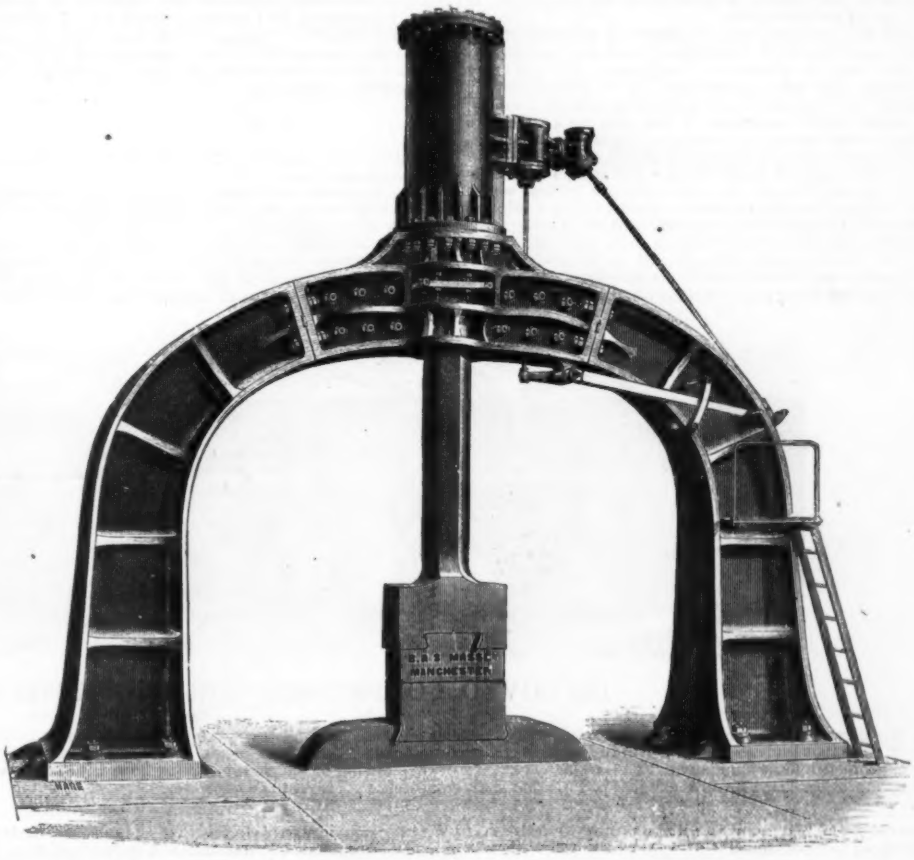
L. Zehnder is of the opinion that atmospheric electricity is produced by the friction of the air (wind) on the surface of the earth. The positively charged air rises at the equator to the upper regions of the atmosphere, and becomes distributed, in consequence of the mutual repulsion of its particles, over the whole surface of our atmospheric envelope. Although the tension of the electricity in the first portion is slight, it is increased by the continuous inflow of air slightly charged with electricity, until the tension becomes so great that it is discharged by combining with the negative electricity on the earth, causing thunder storms, auroras, etc.—*Dingl. J., p.* 395.

IMPROVED STEAM HAMMER.

WE give an illustration of a powerful steam hammer, recently constructed by Messrs. B. and S. Massey, Openshaw, near Manchester.

The hammer presents some important improvements as compared with those usually constructed of this form. The stuffing box is accurately worked out by machine tools to the same section as the piston rod, and the gland, which is of steel, is machined in every part to insure an accurate fitting to the stuffing box as well as to the piston rod. In addition to this the opening in the framing below the gland is carefully machined to the precise dimensions and sections as the piston rod, and this forms a deep guide. By these arrangements the piston and rod, when at the lowest working position, have a guide 5 feet 10 inches deep; and if the work on the anvil is only 14 inches high, the piston rod has a minimum guide 7 feet deep, which, with a piston rod 1 foot 6 inches diameter, secures ample rigidity and accuracy in delivering the blow. The two halves of the framing are planed all over and secured by turned bolts fitted tightly into reamered bolt holes, and further secured by planed keys.

The central web of the framing is made thicker in the lower panels than above, giving ample strength combined with moderate weight in the upper part. The valve gear allows the hammer to be worked either double or single action, the steam being either admitted to the top of the cylinder or shut off from it at the discretion of the attendant. The valve gear is so arranged as to be perfectly under command, so that although the design permits the use of stop blocks or a stop lever to prevent the piston rising too far, these are found unnecessary, and, in fact, the workmen prefer to be without them. The piston and piston rod were forged solid from the special iron produced by the Mersey Forge. Nominally the hammer is 10 tons, but the falling weight, exclusive of top steam, is nearer 11 tons. The stroke is 84 inches, and the width inside the arch, 18 feet.—*The Engineer.*



IMPROVED TEN-TON STEAM HAMMER.

COMPRESSED AIR LOCOMOTIVES FOR MINES.

THE question of underground haulage is every day becoming of more and more importance in measure as the fields of exploitation extend, and the working centers become more distant from the whim shafts. The constant increase in labor, on the one hand, and the necessity of satisfying the requirements of the industries, on the other, have naturally led mining men to study mechanical means of haulage, the only ones that are capable of realizing these two important conditions—economy and rapidity of carriage.

The ever-increasing cost of horses and their food sufficiently showed, at first sight, the economic results, aside from other advantages, that were to be obtained by substituting engines for animal traction. In the first place, use was made of chains or cables set in motion by stationary engines. Over these, however, small independent engines present the following advantages:

1. The first installation is simpler, since the pulleys, rollers, chains, etc., that the cable system require are done away with.

2. They do not, like the chain, require a double track and a special gallery for the workmen, this being indispensable in order to prevent accidents.

3. They are able to work alternately in different galleries, and are transportable from one scene of operations to another without much expense; and thus they prevent work from coming to a standstill, as it is easier to have an engine in reserve than to double the chain.

4. Finally, the mechanical power of such engines can be constantly proportioned to the resistance to be overcome, and the engineer is absolute master of it, this being something that is not the case in wire rope systems. In these latter, in fact, the engineman is badly situated for regulating and watching the running of the trains, and the least derailment may become an accident capable of obstructing a gallery for several hours.

We may point out as still another inconvenience of cable systems the necessity, in the majority of cases, of installing steam engines in the mine, with exhaust pipes established in the shaft. In order to avoid such difficulties compressed air has been employed for actuating the cables, but experiments in this direction have not been crowned with success. As an example of the poor results given by wire rope traction in mines, we may cite the Thiers Coal Pit (Compagnie d'Anzin), where it was abandoned after operating but three or four years, although the installation was a very costly one and was arranged with the greatest care.

We believe, then, that when the profile of the roadbed of the gallery and the section of the latter are such that small locomotives can be employed, preference should be given these as a means of haulage.

MEKARSKI'S COMPRESSED AIR LOCOMOTIVE.

COMPRESSED air locomotives differ from steam ones only in the substitution of a reservoir of compressed air for the steam boiler, the motive mechanism being identical. A compressed air locomotive can always be substituted for a steam one of the same power and weight on condition that it has to make, with the same load, a trip of only a few kilometers. We will take, as an example, the most ordinary case—the installation of a haulage in a subterranean gallery in communication with the outside world by means of a working shaft. Without desiring to enter into the details of the Mekarski system, we shall state in a few words the principle of it.

As well known, one of the difficulties, among others, that has been met with in the use of compressed air is that which results from the considerable volume of air that is necessary in order to produce a work of some importance; and, in addition to this, motion is impeded by the congelation of water and of the lubricators.

In the Mekarski system these difficulties are overcome by acting upon the piston, not with dry and cold compressed air, but with a mixture of compressed air and very hot steam. By this means the power represented by a supply of compressed air has been practically doubled, and under such conditions it has become possible to store up, under quite a small volume, a quantity of air sufficient to make a trip of several kilometers.

The motive fluid of which we have just spoken is obtained by passing the air through a column of hot water, whose volume is such that the proportions of the mixture remain nearly constant while the supply of air is being used. The proportion of steam in weight is about one-tenth.

The air thus saturated is distributed to the motive cylinders through the intermedium of a regulator which permits of the pressure being kept constant whatever be that in the reservoirs, or of varying it at will according to resistances or the speed to be obtained.

DESCRIPTION OF THE LOCOMOTIVE.

The locomotives that have been built for employing compressed air under such conditions consist essentially (see engraving) of a frame supported by four wheels, and carrying a double driving mechanism in all respects like that of a steam locomotive. From the upper part of this frame there is suspended, parallel with the axles, a cylinder called a saturator water heater, which contains water at a temperature of 150°; and above this is fixed the reservoir of compressed air. In front there is a platform upon which the conductor sits, having at his left the regulator, with the maneuvering cock that permits of causing the air to act upon either the piston or the brakes. At his right are arranged the reversing lever and the charging column—the latter an arrangement of pipes and cocks that serve to charge the locomotive. We give, as an example, the principal dimensions, etc., of the two types that are in operation at the mines of Graissessac (Herault):

	Type No 1.	Type No. 2.
Total length	2·76 m.	3·4 m.
Total width	1·1 m.	1·12 m.
Height	1·55 m.	1·06 m.
Capacity of heater	75 liters.	80 liters.
Supply of air, in weight	55 kilos.	77 kilos.
Capacity of air reservoir	1,500 liters.	2,100 liters.
Diameter of motive cylinders	0·12 m.	0·22 m.
Stroke of piston	0·21 m.	0·18 m.
Weight when charged	2,300 kilos.	3,500 kilos.
Maximum tractive stress (adhesion 0·1m.)	230 kilos.	350 kilos.
Horse power in developing the maximum stress at a speed of 10 kilometers	8·5	12·5

The discharge of compressed air from these engines, on a level roadway, is, for each kilometer passed over, about one kilogramme per ton of train.

THE STATIONARY APPARATUS.

The installation of a system of haulage by compressed air locomotives presents no difficulty. From the dimensions of the types that we have just spoken of, it will be seen that these engines are capable of running, with their maximum charge, and without being recharged, from 5 to 6 kilometers. This is precisely what is necessary in order to make a trip back and forth under the ordinary conditions of practice. It will suffice, then, to charge the locomotives after each return trip, an operation that may be effected at one of the extremities of the gallery, near the working shaft. The charging consists in filling the compressed air reservoir, and, at the same time, in heating the water in the saturator.

The Compressors.—The compressors used for compressing the air to 30 atmospheres are of a special type that has been studied out by the Sociéte Generale des Moteurs à Air Comprime. The apparatus consists of two single acting pump chambers, an arrangement which permits of the elevation of temperature being more efficaciously combated and consequently of reducing the motive work to be expended, and which, besides, presents the great advantage of at once rendering apparent the least leakage through the piston packings.

The first pump forces the air into an intermediate reservoir under a pressure of 5 kilos, and the second sucks it out of the latter and forces it into the accumulators under a pressure of 30 kilos, after having caused it to traverse a cylinder called the drier, in which it becomes freed from the injection water. The non-working face of the small cylinder is in communication with the intermediate reservoir—an arrangement favorable to the tightness of the packing, the arrangement of which is the same as in the first cylinder.

The heating that compressing tends to produce is overcome in the large cylinder by an injection of water that takes place at the same time as the sucking of the air, and by a circulation of cold water around the small cylinder.

Compressors of this type give regularly a product in volume of 0·75 to 0·80 per cent. It is, in fact, daily ascertained in the engines of the Nantes Tramway Co., that their effective production, measured from the effective discharge of the locomotives, is 11 kilogrammes of air per 100 revolutions of the engine. Comparing this figure with the volume sucked up theoretically in the large cylinder of the pump (which is 11·78 cubic meters per 100 revolutions), the practical product amounts to

$$\frac{11}{11{\cdot}78 \times 1{\cdot}22} = 0{\cdot}76;$$

1·22 kilos being the weight of one cubic meter of air at a temperature of 15°.

These apparatus are placed above ground at the mouth of the working shafts, and are driven by either stationary or movable steam engines.

Accumulators and air pipe.—The compressed air is led to the accumulators (which are reservoirs of from 2,000 to 4,000 liters capacity, placed at the bottom of the mine, at the charging place) by means of a pipe of very small diameter. We may state in regard to this that a pipe 40 millimeters in diameter is sufficient to transmit to a distance of more than 500 meters (with a loss of charge of 1 or 2 atmospheres only) the compressed air furnished by a 75 H.P. compressor, capable of supplying eight locomotives. The charging is done by putting the locomotives in communication with the accumulators by means of pipes provided with couplings.

Reservoir and steam pipe.—As for charging with steam, this is done in just as simple a manner. The steam is taken from generators placed above ground. At the bottom of the mine there is situated a small water reservoir of a capacity of 1,000 liters, kept at a proper temperature by means of a steam pipe of very small diameter, which keeps it in constant communication with the boiler above. It is by putting this reservoir in communication with the saturator of the locomotive, and by an injection of steam, that the water that the saturator contains is carried to the proper temperature. As we have said, the pipe that leads the steam from the generators is of very small diameter (about from 0·02 to 0·03 m.). It is very easy, and costs but little to properly jacket these small pipes in order to prevent condensation, although, in this case, the latter presents no inconvenience.

POWER OF A SYSTEM.

We herewith give the elements for calculating, in general cases, the power and the number of compressing machines and locomotives.

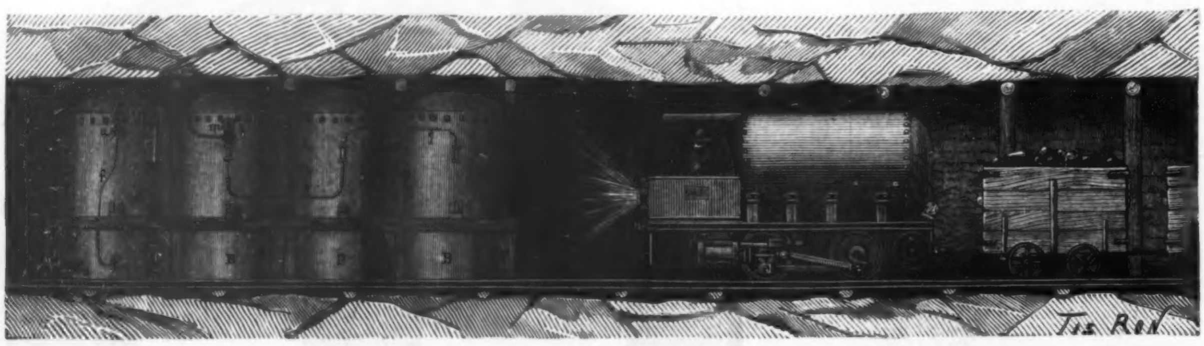
Locomotives.—The number of locomotives is determined by the number of trains to be hauled per hour, a figure which is itself determined by the local conditions in adopting (inclusive of the time consumed in maneuvering and charging) a speed of 8 to 10 kilometers per hour.

The numbers of cars to be hauled by the locomotives must be determined in such a way that on a rising grade (0·012 to 0·015 m.) the locomotive shall draw, in ascending, twice its own weight. This is a very simple rule, that well corresponds to the tractive stress that can be required of these engines.

Compressing machine.—For the production and consumption of compressed air two figures must be considered: One kilogramme of air compressed to 30 atmospheres, under the conditions found in the Mekarski system, furnishes a minimum effective work of 12,500 kilogrammeters measured at the felly of the driving wheels of the locomotive. The compression of the same weight of air requires 45,000 kilogrammeters measured upon the shaft of the motor.

The number of locomotives that are necessary having been determined, we may still more simply count, for the power of the engine of the compressor, on 8 to 10 horses per locomotive in operation.

Accumulators.—As for the capacity of the accumulators, that is determined according to the work that is to be stored up while the locomotive is running and the time that can be allowed for the charging. It is from such data that the mechanical haulage by Mekarski's compressed air locomotives was organized at the Graissessac mines.—*Le Génie Civil.*



IMPROVED COMPRESSED AIR LOCOMOTIVE FOR MINES.

A, Steam reservoir in constant communication with the boiler outside. *o*, Pipe that leads the steam from the boiler. *a*, Three-way cock for charging with steam or hot water. *f*, Pipe that leads the hot water to the cock, *a*. *m*, Pressure gauge. *n*, Water gauge. *r*, Blow-off cock.
B, Compressed air accumulators. *b*, Charging cock (three-way) allowing of the charging being done with the air contained in the reservoirs or with air coming directly from the compressor. *m*, Pressure gauge. *p*, Pipe that leads compressed air from the compressor.

TORPEDO BOAT GUNS.

ONE type of gun which is now being largely adopted in Continental and other foreign natives for arming the so-called first class and larger sized torpedo boats, is the 37 mm. (1·46 in.) Hotchkiss revolving cannon; the total weight of this gun with its pivot and socket is 550 lb. It can be worked by two men and fired at the rate of about sixty shots per minute, the explosive shell employed having an energy sufficient to penetrate any existing torpedo boats, while canister can also be used against open boats at short ranges. As the recoil is very slight, no strengthening is necessary from this cause for the torpedo boats.

This gun is, however, considered too heavy for the armament of the lighter second class torpedo boats, for which purpose Messrs. Hotchkiss and Co. are now manufacturing a rapid-firing single barrel gun adopted for the same ammunition as the 37 mm. revolving cannon. This class of gun has been adopted to a greater or less extent in fifteen different natives, and is described by *Engineering* as follows:

Figs. 1 and 2 are general views of this gun, which resembles a large wall piece mounted on a pivot; the breech block slides vertically through a mortise and is actuated by a lever, forming at the same time the trigger guard. As will be seen, it is provided with a stock, which bears against the left shoulder of the operator, and on the right is a pistol grip for pointing, so that without the aid of any elevating or directing mechanism the work of sighting and firing (as is the case with the revolving cannon) is placed in a single hand, which, the makers claim, gives more accurate work, and better results are obtained than with any combination of men to sight and fire. The body of the gun is made of Whitworth's fluid compressed steel; it is square at the breech, and the trunnion ring (of steel) is screwed on in such a place that the gun is exactly balanced in the trunnions. The breech action consists of the square wedge, A, with rounded corners, as shown in the details. It runs in guides, BB, on each side, and its run is limited by the set screw, *p*, Fig. 6. It is moved up and down by means of the crank, C, bearing in the right side of the breech, the pin, *c*, of which works in a curved groove, D, in the wedge. This crank, C, carries the lever handle, E, which serves to open the breech by pushing it downward and away, and to close the same by drawing it toward the pistol grip. The firing mechanism consists of a hammer, F, with a point which penetrates the firing plate and strikes the cap in the cartridge on pulling the trigger. This hammer, F, is mounted on a rocking shaft, G, which is provided with an arm, *g*, on the outside of the wedge.

The lever handle, E, carries a cocking cam, *e*, which bears on the arm, *g*, of the rocking shaft, and in this manner by swinging the lever handle downward the hammer, E, is drawn backward, or cocked. There is a small projection, *f*, on the hammer and a trigger sear, H, which catches on this projection and holds the hammer back until released by pulling the trigger, which in turn catches on the trigger sear, H. The V shaped mainspring, I, is carried by the hinged piece, K, arranged so as to be easily opened in case the spring should break and require replacing. The upper branch of the spring bears against a projection on the hammer, F. The cartridge extractor, I, is a prismatic piece of steel, forming at its further end the hook, *l*, and running in a recess on the interior left cheek of the breech and parallel to the bore of the gun. It has on its under side a stud, *l'*, which works in a groove, M, on the left side of the wedge. This stud, *l'*, for a time runs in the straight portion of the groove, but as soon as the wedge is so far withdrawn that the opening, N, coincides with the chamber, the stud runs in the inclined part of the groove which causes the extractor to be moved back quickly, and the fired cartridge case is in this manner extracted and thrown out of the gun.

The stock, O, is of wood, fitted into a gun-metal holder; it is attached to the breech of the gun by the screw, P. The stock can be dismounted by turning the screw a quarter of a turn. To prevent the slight shock of discharge being felt by the gunner there is an India-rubber tube, *o*, attached to the back of the stock; this forms a very elastic buffer. The pistol grip, Q, is of gun metal; it is hollow, and is attached to the breech by two screws. This carries the trigger, *q*, and serves at the same time to direct the gun by means of the right hand, thus leaving the left hand free to feed in the cartridges.

The front sight is a plain steel point attached by a collar to the gun. The rear sight is a folding leaf, which has a certain number of fixed sights with the usual notch, corresponding to elevations from 200 to 200 meters, and giving at the same time the permanent deviations, so that the gunner

may pass from one range to the other without interrupting the fire.

The pivot and socket are of gun metal, the case of the latter being made according to the shape of the conning tower, or other part of the boat to which it is to be fixed. The pivot carries the gun by its trunnions, and fits in the socket so that it can rotate, thus forming a universal joint, and allowing the gun to be trained in any direction. In order to reduce the action of the recoil on the boat as much as possible, the following description of recoil buffers is applied to the pivot.

The trunnion bearings are bored considerably larger than the diameter of the trunnions, and the circular space between the two is filled with soft India-rubber, entirely inclosed in flanged rings which fit over the trunnions and in the trunnion bearings, so that on the action of the recoil a certain flow of the rubber takes place, and allows in this manner a recoil of a few millimeters in the trunnion bearings, sufficient to reduce the sharp shock on the fastenings without in any way causing inconvenience to the gunner.

One man can, with a little practice, fire this gun with the

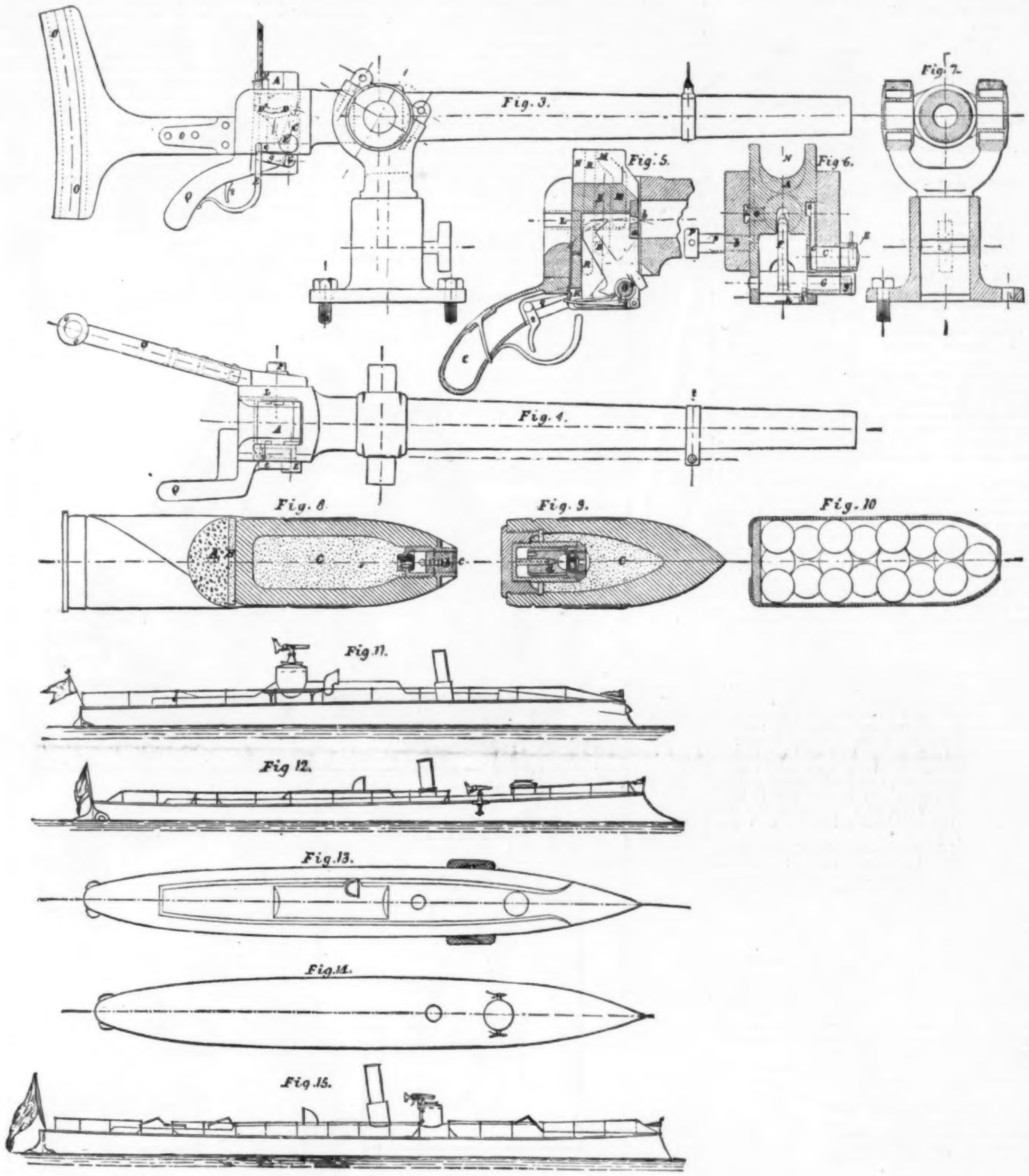


FIG. 1.

FIG. 2.

THE HOTCHKISS 37 MILLIMETER TORPEDO BOAT GUN.

rapidity of about twenty shots per minute, but the time required, if the shots are carefully aimed, is far greater. The following are the principal dimensions:

Caliber		37 mm.	1·46 in.
Length of bore (20 calibers)		740 mm.	29·14 in.
Helicoidal rifling left hand twist.	Number of grooves	12	12
	Depth of grooves (uniform)	0·4 mm.	0·016 in.
	Width of lands (uniform)	2 mm.	0·08 in.
	Pitch of rifling (in calibers)	29·9	29·9
	Angle of rifling	6 deg.	6 deg.
Weight of gun		33 kilos.	72·6 lb.
Length of gun without the stock		840 mm.	33·08 in.
Total length of gun with the stock		1140 mm.	3 ft. 8·88 in.
Weight of pivot and socket		25 kilos.	55 lb.
Ammunition.			
Total weight of shell charged and fused		450 gr.	15·84 oz.
Bursting charge		22 gr.	0·77 oz
Length of projectile		33 mm.	1·30 in.
Charge of powder		80 gr.	2·8 oz.
Weight of metallic cartridge case		95 gr.	3·34 oz.
Total length of complete cartridge		167 mm.	6·57 in.
Total weight of complete cartridge		630 gr.	1·2 lb.
Initial velocity with ordinary French Ripault cannon powder		402 m.	1318 ft.

The manipulations for loading and firing are: 1. The lever handle is thrown down by pressing with the thumb of the right hand. 2. The cartridge is inserted with the left hand. 3. The lever is returned to place with palm of the hand, which raises the block to its proper position, when the gun is ready for fire. After firing, the lever is thrown down sharply, and the empty cartridge shell is thrown clear of the gun.

The manner in which the gun is fitted on the torpedo boat will greatly depend on the construction of the vessel, but in most cases placing it on the conning tower appears the easiest and best, as nothing else is necessary but to bolt the socket on the top of the tower. The gunner is fairly protected by the conning tower and the mounting of the gun itself against the enemy's fire. On the second-class torpedo boats, the single barrel rapid firing gun can usually be mounted sufficiently high so as to clear the funnel, thus giving an all round fire. A light grating is then necessary for the gunner to stand upon so as to give him the necessary height to work the gun. This arrangement has been tried in Denmark and Austria with entire success, and is shown in Fig. 11.

In the first-class and larger boats where the funnel is placed abaft the conning tower, and too high to be cleared by the gun, it will often be found advisable, so as to obtain a fore and aft fire, to use a pair of single barrel guns, one mounted on each side of the vessel, an arrangement adopted by the Russian and Victorian (Australia) navies, but this manner of placing the guns would only be practical on large torpedo boats, as it requires columns fitted like boats, davits, which can be dismounted if necessary, and small hinged gratings projecting over the sides of the boat for the men to kneel upon to work the guns. The total of fittings in this case would make about 150 lb. additional weight for each gun. (See Figs. 12 and 13.)

By mounting one of the guns on each side of the conning tower, instead of on special columns, a fore and aft fire can be obtained with less weight than in the preceding case, as the socket for the gun pivots can be fitted direct to the sides of the conning tower, and its strength can be utilized for absorbing the action of recoil (Fig. 14).

In large torpedo boats, the revolving cannon will be best mounted on the conning tower as shown in Fig. 15.

The number of rounds of ammunition for each gun will naturally be greatly affected by the total weight considered possible for the boat to carry without too great a loss of speed. The time any torpedo boat would be able to use its gun will be extremely short, and therefore no doubt 120 rounds per gun would be sufficient, particularly for the boats attached to the larger vessels, in which case the replenishment of ammunition is comparatively easy.

The total weight of gun, ammunition, etc., would be distributed as follows for a single barrel Hotchkiss gun:

	Kilos.	Lb.
Weight of 37 millimeter single barrel rapid firing gun	34	74·8
Weight of universal pivot for same	15	33
" " socket and fastenings	10	22
" " accessories and reserve parts	7	15·4
120 rounds of ammunition, each 630 gr.	75·5	166
Two steel plate ammunition chests, each to carry 60 rounds, each 10 kilos. 250 gr.	20·5	45·1
Total	162	

THE WILSON SOLAR EVAPORATOR.

To the Editor of the Scientific American:

In the SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 405, page 6461, I have had the pleasure of reading a fair description of an apparatus invented by me, and established at Salinas, Antofagasta, on the coast of Bolivia, for the conversion of salt water into fresh by the action of the sun's rays. Allow me to state that the said establishment, although not now in my possession, is still in good working order, and produces the same quantity and quality of fresh water as it did when first established. It has now during the eleven years of its existence, saved to posterity the not insignificant amount of upward of sixteen thousand tons of coal, which otherwise would have been consumed had the old boiler establishments remained that were on the spot when this invention was successfully planted.

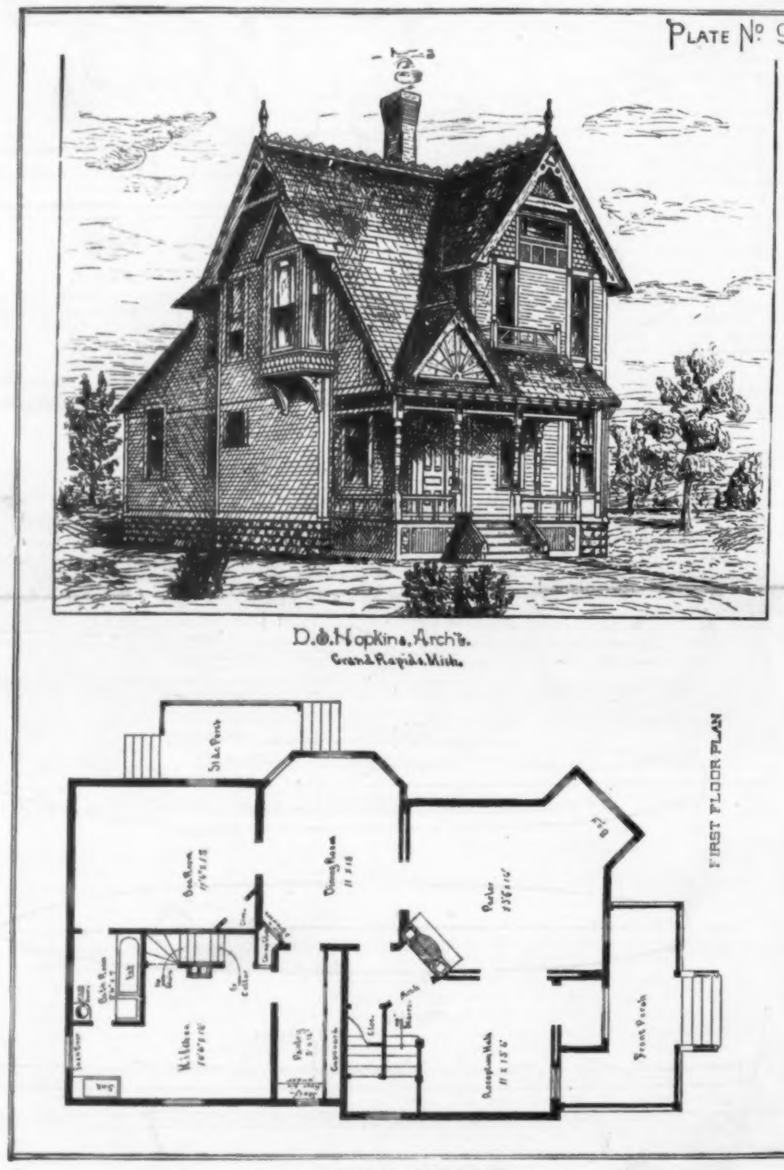
I also take the liberty to ask, and should be happy to learn through the columns of the SCIENTIFIC AMERICAN, if any prior invention of a similar nature has ever been recorded, or if the above mentioned apparatus is the first that practically has made use of the sun's rays to supply a want that otherwise could only have been obtained by the use of a combustible.

Very respectfully yours,
CHAS WILSON,
Late of Brooklyn, N. Y.

Iquique, Peru, 3d December, 1883.

A $2,000 HOUSE.

WE give plans and elevations of a Western cottage designed by D. S. Hopkins, architect, Grand Rapids, Mich. "The plan," he says, "is one that generally pleases the people of this section, and is admirably adapted to their wants. I built this house during the past season for a speculator, under contract for $1,740, without plumbing. I call it a $2,000 house, however, as the contractor says it can not be built for much less. It is of a semi-colonial style—not so much so, perhaps, as some of the houses East, but I think more pleasing, and certainly more adapted to the climate of this State."—*Builder and Wood-Worker.*



A $2,000 HOUSE.

THE NEW HOUSE OF PARLIAMENT IN VIENNA.

BY removing the walls that formerly surrounded the center or old part of the city of Vienna, an enormous tract of land was made available as building plats, and the Austrian Government, as well as the municipality and citizens of Vienna, have availed themselves of the opportunity of making the city one of the finest in the world, by erecting ornamental and handsome edifices on the Ring Strasse, which forms a circle in the heart of the city, in place of the old fortress walls.

Among some of the handsome buildings erected here are the Votive Church by Ferstel, the Museum of History and the Museum of Natural Sciences by Semper and Hasenauer, the University, in the Renaissance style, by Ferstel, the Gothic Town Hall by Schmidt, the New Court Theater, and finally the new House of Parliament, designed by and erected under the supervision of the well-known architect Theophil von Hansen. Von Hansen has made the Greek style of architecture a specialty, and by his last great work, the above mentioned House of Parliament, he has given ample proof that a building of this kind can be erected as well in the Grecian style of architecture as in the Renaissance and Gothic, which styles have usually been employed in such buildings heretofore.

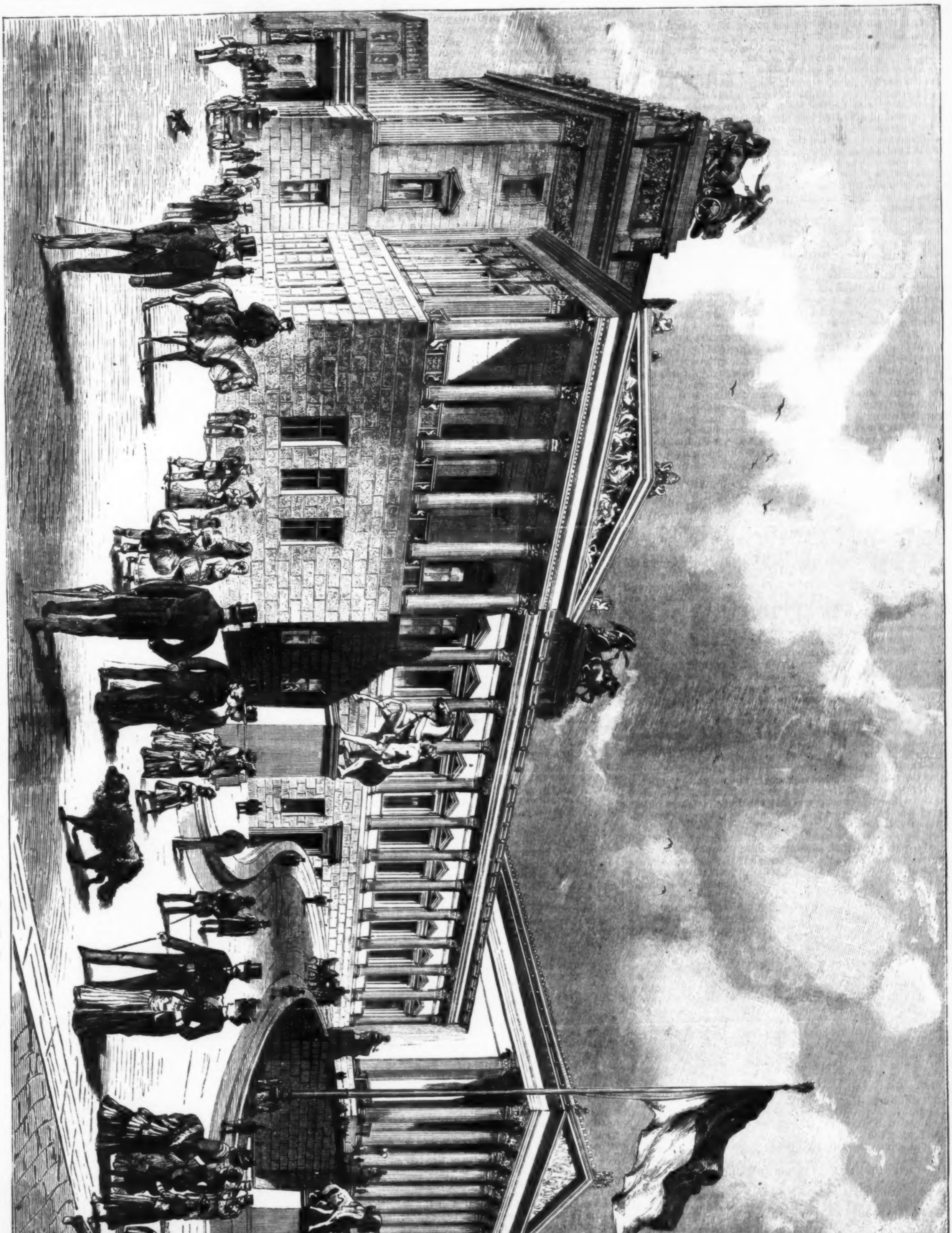
The new House of Parliament is 468 feet long, and 449 feet wide. The building is only one story high, but is provided with a very high sub-story or basement of rustic masonwork, which gives the entire building a massive and imposing appearance. In the middle of the building a grand portico crowned by a pediment is erected, which contains twelve columns arranged in two rows, the columns being 40 feet high. At both sides of the portico wings are erected, the facades of which are formed of upright columns supporting the entablature, between which columns windows are arranged. The end pavilions are each provided with a portico supported by six columns, and behind the same square buildings are erected, which are crowned by atticas ornamented with sculptures and figures. The corners are highly ornamented by means of reliefs, and support bronze chariots drawn by horses, which are driven by Goddesses of Liberty occupying the chariots. At each end of the building a porte cochère supported by caryatides is arranged. In the above mentioned square buildings the two assembly halls are located, one for the House of Lords, and the other for the House of Representatives. In front of the building two curved inclined approaches are arranged, which lead from a point near the end pavilions to the central portico, and serve as carriage driveways. The columns and ornamentation on the front are all in the Corinthian style, and the outer appearance of the building is so arranged that it distinctly shows the arrangement of the interior.

In the central part of the building, the front of which is formed by the portico, is a vestibule corresponding to the pronaos of the Greek temples, which contains the staircase which leads to the first story from the sub-story. Beyond the vestibule a grand hall for State festivities is arranged, which is decorated most lavishly. It is a temple 134 feet long, 75 feet wide, and 41 feet high; the roof is supported by two rows of twelve columns, each 29 feet high, and consisting of a monolith of red marble provided with a gilt capital. The columns form a passage 23 feet wide around the hall in the same manner as in a hypaethral temple. The walls are covered with bluish gray Pavonazzo marble, and the floor is formed of polished light gray tiles, each surrounded by a red border. The columns support a highly ornamented lacunar ceiling, provided with numerous sky-lights, and the naos is provided with a glass roof ornamented with ivy branches, which is a substitute for the open naos of the Grecian temples. Below the ceiling is a frieze 328 feet long painted in encaustic colors on a gold ground, representing the history of mankind. The beauty of the proportions, the brilliancy of the material, and the combined influences of the design in general and the beauty of execution produce an effect that is grand and marvelous. This central hall forms the heart of the structure, and is to be used for State occasions, for instance when the Emperor is to meet the Peers and Representatives, etc.

The halls for the Peers and Representatives are arranged as semicircular amphitheaters; the straight wall behind the President's chair or desk is ornamented by porticoes of Ionic columns, between which niches and spaces for pictures and statues are arranged; the semicircular side is provided with two galleries supported by eighteen Hermes of white marble. Each hall is provided with a glass roof, the roof in the hall for the Representatives being ornamented, but the hall of the Peers is left plain, according to their wishes.

Besides the above mentioned rooms, reading rooms, restaurants, libraries, and other rooms for clerks, etc., are arranged in different parts of the building. All parts are painted or otherwise ornamented in color. Mr. Hansen desires to give the facade throughout a polychromatic ornamentation, but it is doubtful whether his wishes will be carried out or not. Several parts of the front have been ornamented in this manner, and seem to verify his statement that the building will only be complete, and will produce the effect desired, only when provided with this polychromatic ornamentation.

The cut given opposite is taken from the *Illustrirte Zeitung.*



THE NEW PARLIAMENT HOUSE, VIENNA. Drawn by L. E. PETROWITSCH.

A NEW RESIDUAL PRODUCT FROM COAL GAS.

At a recent meeting of the London Section of the Society of Chemical Industry, Mr. H. Leicester Greville, F.I.C., F.C.S., read the following paper on "A New Residual Product from Coal Gas."

It may be as well to state at once, without further prelude, that the new residual product from coal gas about which I wish to make a few remarks this evening is carbon disulphide. It has long been known that this substance is present in crude, and to a limited extent in purified gas; but I believe that I am correct in terming it "a new residual product," as the samples exhibited this evening are probably the first specimens of carbon disulphide that have ever been shown of the material in bulk prepared from coal gas. I may also state that I have operated on several tons of the raw material from which it is prepared, and have obtained more than 1 cwt. of the liquid product; so that the preparation has been carried beyond the region of a simple laboratory experiment, and has been transferred to a sufficiently large working scale to come practically within the domain of a commercial operation.

Before proceeding further, it will be necessary for me to briefly explain the system of purification in use at the Commercial Gas Works, under the direction of the Chief Engineer, Mr. H. E. Jones. This is absolutely requisite, from the fact that it is only by a method of purification conducted in this special manner that the raw material from which it is possible to obtain the carbon disulphide is produced. It may also be stated, in passing, that a description of the special process used at the Commercial Gas Company's manufacturing station may be all the more interesting from the fact that I believe it to be the best system for combining the maximum of efficiency with the minimum of nuisance. In making this statement, I am speaking advisedly, and from some years' practical experience, combined with the circumstance of my having made the subject one of special study in my own particular domain as a chemist.

Starting *ab initio*, the crude gas (after reduction to mean atmospheric temperature, by suitable condensing plant) contains, per 100 cubic feet:

Ammonia........	190	to	280	grains.
Sulphureted hydrogen........	900	"	1100	"
Carbonic acid........	970	"	1099	"
Sulphur as organic sulphur compounds (principally carbon disulphide)	30	"	48	"

The ammonia is extracted by suitable washers and coke scrubbers, and carries with it a definite amount of associated impurities. The sulphur, as carbon disulphide and organic sulphur compounds, is not affected. The gas then enters a series of large purifiers charged with lime and oxide of iron (hydrated ferric oxide), where the whole of the carbonic acid and sulphureted hydrogen is extracted, together with a small proportion of the carbon disulphide. The management of these purifiers is conducted with the greatest care, tests being taken twice daily. In addition, the composition of the crude gas entering the vessels is ascertained every alternate day. These tests are made with the Harcourt tests, which, under intelligent supervision, afford, in a comparatively short time, results sufficiently reliable for practical purposes. According to the results of these tests, the relative quantities of lime and oxide in the vessels are varied the object being to so proportion the two materials to the condition of the gas to be purified, that the oxide takes out the whole of the sulphureted hydrogen and the lime the whole of the carbonic acid; the gas at the outlet of the series being free from both these impurities. The result of this system of working is that the lime is taken out almost wholly as carbonate, the oxide having absorbed the sulphureted hydrogen. Each kind of impurity is, therefore, eventually removed in the most innocuous form; and the importance of this, as a question of nuisance, is obvious. Working in a less scientific manner, it is difficult, if not impossible, to insure a similar result; for if the proportion of lime is deficient, carbonic acid is not thoroughly eliminated. This is objectionable, not only from this form of impurity acting injuriously on the illuminating power of the gas, but also from the fact that it materially interferes with the subsequent purification of the gas from the carbon disulphide. If, on the other hand, the proportion of oxide is insufficient, part of the sulphureted hydrogen, which should have been removed from the purifiers in the innocuous form of iron sulphides, is absorbed by the lime, and is removed as calcium sulphydrate—a compound which, on being exposed to the air, heats, and evolves sulphureted hydrogen. It is, indeed, due to this action that the main nuisance arising from ordinary gas lime is due; and the evil becomes the more exaggerated, the greater the proportion of sulphydrate. In the spent material from gas purifiers, where the purification is carried out on less scientific principles, the amount of this compound present is sufficiently great to be the source of considerable nuisance.

We have now arrived at a stage in which the gas is free from sulphureted hydrogen and carbonic acid, and contains a diminished quantity of sulphur compounds, amounting (as a mean) to about 30 grains. In order to conform to the standard of purity now required, it is necessary that this amount should be considerably reduced. This is effected in a special series of purifiers prepared in a special manner. These vessels are charged entirely with lime, and are subsequently prepared for use by the passage of gas free from carbonic acid, but containing the maximum possible quantity of sulphureted hydrogen. After impregnation with a certain amount of the latter impurity, the material acquires the property of absorbing carbon disulphide from gas exposed to its action. The explanation of this action most generally received is that calcium sulphide is first formed, thus:

$$CaH_2O_2+H_2S=CaS+2H_2O,$$

and that the calcium sulphide subsequently unites with carbon disulphide to form calcium sulphocarbonate, thus:

$$CaS+CS_2=CaCS_3.$$

The ordinary product of the action of sulphureted hydrogen diluted with neutral gases upon calcium hydrate is, however, calcium sulphydrate—a compound which does not appear to unite with carbon disulphide; and if the generally received theory about the action of these sulphide vessels (as they are termed) is correct, it must be assumed that the calcium sulphydrate first formed splits up, as the temperature of the mass rises by the heat of combination, into calcium sulphide and sulphureted hydrogen. Such a view appears, indeed, to be corroborated by the fact that at very low temperatures an efficient vessel cannot be prepared; and that the higher the temperature during the action of the sulphureted hydrogen, the greater the subsequent efficiency of the material. We find, in practice, that each vessel containing about 70 yards of lime when slaked takes up about 6 tons of sulphur as sulphureted hydrogen before allowing an appreciable quantity of this impurity to pass. A vessel so charged will, on first being used as a sulphur purifier, reduce the sulphur from 30 or 40 grains down to between 7 and 10 grains; diminishing somewhat in efficiency when the maximum amount of gas is passing—an effect attributable to the increased velocity diminishing the period of contact. When once prepared, these sulphide vessels are, as a rule, used only for clean gas. A little additional quantity of sulphureted hydrogen going into them occasionally does no harm; but particular care is exercised to keep the gas entering them scrupulously free from carbonic acid, the admission of which would liberate a corresponding quantity of the carbon disulphide previously absorbed, and thus render the exit gas more impure than that entering the vessel. These vessels (of which we have four at the Stepney station of the Commercial Gas Company) last, when carefully and systematically used, from one to two years; during which they will more or less purify from about 730 million to about 1,000 million cubic feet of gas. In these figures, I am referring to the four purifiers in the aggregate. Sometimes one is used, sometimes another; more frequently two or three in sequence, according to the condition of the gas and the general exigencies of the case. A vessel is taken off when it ceases to do work on the sulphur compounds; and so long as it does work, even to the amount of a reduction of only some 5 grains of sulphur per 100 cubic feet of gas, the vessel is kept in use.

The lime, on being discharged, is totally distinct in character from ordinary spent lime; the prevailing color being a bright orange red. The material heats very little on exposure to the air, and no nuisance arises from it; the only smell being a faint one of carbon disulphide. The dry material oxidizes but slowly; though in the presence of moisture the oxidation takes place at a quicker rate, the prevailing red color gradually disappearing, and the eventual product being perfectly white. I was much struck with the vivid color of the recently discharged material on the first occasion that I witnessed the discharge of a sulphide vessel at our works; but I came to the same conclusion that would probably have been formed by other chemists—viz., that the orange-red compound was calcium sulphocarbonate. I, however, noticed that in cases where the material heated more than usual in a partially confined space, the odor of carbon disulphide became very perceptible; and the effect of a gas-flame being in the atmosphere was the development of a sufficiently strong odor of sulphurous acid to produce an unpleasantly irritating effect on the organs of respiration. Mr. Jones also informed me that on one occasion, when a sulphide vessel had, from accidental circumstances, heated in use, the proportion of sulphur in the outlet gas rapidly increased; proving the partial liberation of bisulphide. Eventually, I tried the effect of exposing a portion of the orange compound to heat; and was somewhat surprised to find that, by the simple process of distillation with water, liquid carbon disulphide was obtained with the greatest facility, and in a condition of comparative purity. I say that this result somewhat surprised me, as it is generally understood that the alkaline sulphocarbonates, in the presence of water, form, upon the application of heat, carbonates, with evolution of sulphureted hydrogen. Thus, in Watts' "Dictionary of Chemistry," vol. v., p. 493, the following statement occurs:

The sulphocarbonates of the alkali metals and alkaline earth metals are red, brown, or yellow compounds, soluble in water and in alcohol, and in some cases crystallizable. They are easily converted into carbonates, by heating their aqueous solutions; water being decomposed, and sulphydric acid evolved—*e. g.*,

$$K_2CS_3+3H_2O=3H_2S+K_2CO_3.$$

A similar decomposition takes place thereby in the aqueous solution at ordinary temperature.

The discovery of the facility with which carbon disulphide could be obtained from the spent lime from the sulphide vessels naturally suggested the practical utilization of the reaction on a larger scale. As a preliminary, selected samples of the material were tested quantitatively in the laboratory by simple distillation with water; the following results being obtained:

Sample No. 1	4·00	per cent. by weight.
" 2...........	3·00	" "
" 3	3·90	" "
" 4	4·04	" "

Wishing to test the process on a larger scale, Mr. Jones kindly placed at my disposal a boiler capable of holding several hundredweight of material; and this I had fitted up with perforated false bottom, pressure-gauge, and the necessary connection for admitting steam and conducting the evolved vapors to a condensing worm. With this apparatus I made a series of careful experiments on the *average* spent material from a recently discharged sulphide vessel, which I could judge, from the amount of the prevailing color, to be a fairly average specimen. The practical result was that the yield of carbon disulphide amounted to from 1 to 2 per cent. of the weight of substance taken. The difference between this practical result and those of the laboratory trials is accounted for by the fact that the last named tests were made on picked samples, while the larger trials were conducted on average bulk.

I was somewhat disappointed at the practical trials giving so small a yield; more especially considering that the amount of carbon disulphide absorbed by the material when in the purifying vessel was about 4 per cent. by weight. But a little reflection made the question more clear. The purifiers used for carbonic acid and sulphureted hydrogen are constantly charging the gas with excess of aqueous vapor from the water of hydration of the calcium hydrate during its conversion into carbonate, and that of the ferric oxide during its change to sulphide. A portion of this aqueous vapor condenses in the vessels in which it is formed; and practical evidence is afforded of its presence by the condensation of many gallons daily of liquid draining from the vessels while in action. The gas, however, leaves this series of vessels at a considerably higher temperature than the surrounding air, in consequence of the liberation of heat due to the reaction between the lime and oxide and the carbonic acid and sulphureted hydrogen. In passing subsequently through the sulphide vessels, the gas becomes more or less cooled; no doubt much of the cooling action occurring in the spaces beneath the lids, over which there is a constant current of air. In this cooling process, water is separated; and, in descending through the mass of lime, carries with it certain proportions of whatever is soluble. A considerable number of gallons, of a bright orange-red color, are, in fact, daily draining from the vessels when in action; and this effect, extending over the whole of the active life of the vessel, must considerably modify the proportions of soluble constituents in the mass of the solid material when it is eventually discharged, and (among other constituents) the proportions of the particular compound containing the carbon disulphide.

Returning, after this digression, to the results of my practical trials, the small yield of carbon disulphide, taken by itself, would seem to place the question at once beyond the region of any practical issue with regard to the general treatment of the material. In the course of the investigation, however, I found that the residue left in the boiler, after the distillation, contained from 50 to 60 per cent. of free lime, and absorbed both carbonic acid and sulphureted hydrogen freely; so that it would be at least available for recharging a sulphide vessel, and thus save the expense of fresh material. In connection with the whole question, I also elaborated a scheme for which a patent was at one time contemplated; but, on consultation with Mr. Jones, this was abandoned, and I am therefore at liberty to make public the whole of the details. Taking as a starting point 100 tons of the crude material, there would be obtained, on an average, 1½ tons of carbon disulphide, worth say £25. In addition to this, the lime remaining in the boiler would, with a slight addition of fresh material, be available for recharging a purifier; and as the lime for this costs about £35, the saving on this score may be put at about £30, making a total of £55. From this would have to be deducted working expenses; but these could not be very great. My scheme, however, did not end here; and I have now to mention what I consider the most valuable portion of it. In the purification of the gas from sulphureted hydrogen by hydrated ferric oxide, the material after continued use contains about 50 per cent. of free sulphur, and is then sold on a basis of about 7d. per unit per ton; fresh material being purchased in its place. A ton of the spent material fetches, therefore, on a 50 per cent. basis, the sum of £1 9s. 2d. For new oxide of good quality about £1 8s. has to be paid. I proposed in place of selling the spent oxide, to use the crude carbon disulphide for dissolving the free sulphur; the sulphur being eventually obtained in the solid condition by distilling off the carbon disulphide, and the oxide being left in a condition in which it is again fitted for purifying purposes—being, in fact, more efficient in many cases than the new material, and therefore at the very least as valuable. Supposing, therefore, two tons of spent oxide to be thus treated, the result might be stated as follows:

	£	s.	d.
2 tons of 50 per cent. spent oxide are worth,	£2	18	4
They would give—			
1 ton of sulphur at........................	£5	0	0
1 ton of regenerated oxide at	1	8	0
Total................................	£6	8	0

In this process, again, I do not think the working expenses would be large enough to interfere with a good margin of profit; and the carbon disulphide is recovered, with a small loss, in better condition than the crude material. Of course the recovered liquid is again available for the treatment of a fresh quantity of spent oxide. I may state that the extraction of the sulphur from spent oxide by carbon disulphide was carried out for some years by the Gas Purification Company, at their works at Stratford.

Finally, I should like to add a few words as to the possible constitution of the red material from which carbon disulphide can be obtained so readily. The spent lime from the purifiers contains the compound as minute ruby red crystals disseminated through an orange-red matrix. I may state briefly that, from the general behavior of the material, I do not believe that it is calcium sulphocarbonate, but am more inclined to consider it a distinctly new compound. I am making it a subject of investigation; but my results are not as yet sufficiently complete for publication. The investigation is beset with peculiar difficulties, for the raw material, in addition to free lime, contains many compounds soluble in water besides the special one which I desire to isolate. Neither alcohol nor ether affords any means of differentiation. Add to this that the solution decomposes when it is exposed to even a moderate degree of heat, and oxidizes rapidly on contact with air, and the difficulties of the situation will be fully understood. In addition to this, the existing knowledge as to the general behavior of sulphocarbonates, and especially as to any means of systematic analysis, appears to be very limited. The process I have used so far is the distillation of the aqueous solution of the material with excess of lead acetate; the distillate being received into excess of alcoholic potash solution with which the carbon disulphide forms potassium xanthate. So far the method I have adopted agrees with that published by Herr Otto Hehner. Hehner then completes the determination of the carbon disulphide by the well known volumetric process of titration of the solution, previously acidified with acetic acid, with standard copper sulphate, using potassium ferrocyanide as indicator. I have tried this method, and have found it convenient and rapid, but scarcely accurate enough for purposes of investigation. I therefore prefer to treat the somewhat dilute solution of xanthate with a solution of potassium permanganate, until a pink color is shown on shaking the mixture. The whole of the sulphur of the xanthate is then in the form of potassium sulphate; an excess of hydrochloric acid is then added, heat is applied, and crystals of oxalic acid dropped in, until the whole of the suspended manganese dioxide has dissolved, and the solution is bright and clear. The analysis is then completed by the addition of a slight excess of barium chloride, and determining the weight of the resultant barium sulphate in the usual way. This method, which takes some time to describe, is not really a lengthy one in execution; and that these results are accurate is shown by the following figures, in which weighed quantities of pure carbon disulphide were taken:

	Weight of carbon disulphide taken.		Weight of barium sulphate.	Carbon disulphide calculated.
No. 1	7·65	.. ..	47·05	7·670
" 2	11·70	divided into two parts	35·68 .. 5·819	11·690
" 3			35·74 .. 5·871	

I may state that the method I adopted for weighing the volatile carbon disulphide without loss was that of counterpoising a small flask containing the requisite quantity of an alcoholic solution of potash. The carbon disulphide was then dropped in from a fine pipette, and the increase in weight determined. The liquid carbon disulphide, on being delivered, falls immediately to the bottom of the potash solution; and, after weighing, a few slight rotary shakes effect a complete solution and conversion into xanthate without loss. The crude carbon disulphide treated by this method,

after a single distillation at 120° Fahr., to separate any traces of less volatile constituents, gave—

Carbon disulphide taken.	Barium sulphate obtained.	Carbon disulphide calculated.	Percentage of pure carbon disulphide.
10·73	64·60	10·536	98·19
8·54	51·20	8·350	97·77

The mean percentage of pure carbon disulphide is, therefore, 97·98. The solid residue left on distillation at 120° Fahr. amounted to 0·12 per cent., and consisted of free sulphur and oily hydrocarbons.

While I am satisfied that my process of first producing a xanthate, and subsequently oxidizing it by permanganate, gives a correct result, I am by no means so sure that the original treatment of a sulphocarbonate or similar compound by a metallic solution, followed by distillation, gives the whole of the carbon disulphide present; and to this question I am now directing my attention, with the hope of being shortly in possession of a process which shall, without doubt, admit of the correct estimation of combined carbon disulphide. Gmelin states, when speaking of the reactions of the sulphocarbonates, that although the barium, strontium, and calcium compounds, as well as those of the heavy metals, when heated out of contact with air, yield carbon disulphide and a metallic sulphide, in the presence of water the action of heat gives rise to a variety of compounds such as carbonic acid, sulphurous acid, sulphureted hydrogen, and sulphur. If this is the case, it is obvious that, in the first treatment of the carbon disulphide compound by heating with a metallic salt, a portion of the carbon disulphide present may suffer decomposition—a result which would impair the accuracy of the determination. I have a means of proving whether this is or is not the case, and shall try it at the earliest opportunity.

In conclusion, I believe that the whole scheme which I have now laid before you for dealing with the lime and oxide, although possibly not commercially profitable in small gas-works, would become so where the scale of manufacture was large enough to keep fairly employed the special plant necessary. We should then have one more of the impurities of coal gas transferred from the region of trouble and nuisance to that of profit and utility.

LIME AND ITS USES.

LIME is the oxide of the metal calcium, and is known in chemistry as one of the alkaline earths. Its symbol is CaO, its equivalent is 28, and its specific gravity is 3·48. In a state of purity it is a white caustic powder with an alkaline reaction, and so infusible as to resist even the heat of the oxyhydrogen jet. It is obtained by heating pure carbonate of lime, as, for instance, Carrara marble or Iceland spar, to full redness, when the carbonic acid is expelled, and lime is left. Commercial lime, which is obtained by burning common limestone in a kiln, is usually very far from pure. This compound (CaO) is known as quicklime, or, from the ordinary method of obtaining it, as burned lime, to distinguish it from the hydrate of lime, or slaked lime, which is represented by the formula CaO,HO. On pouring water on quicklime there is an augmentation of the bulk, and the two enter into combination; and if the proportion of water be not too great, a light, white, dry powder is formed, and a great heat is evolved. On exposing the hydrate to a low heat, the water is expelled and quicklime is left.

If quicklime, instead of being treated with water, is simply exposed to the air, it slowly attracts both aqueous vapor and carbonic acid, and becomes what is termed air-slaked, the resulting compound in this case being a powder which is a mixture (or possibly a combination) of carbonate and hydrate of lime.

Lime is about twice as soluble in cold as in boiling water, but even cold water only takes up about $\frac{1}{700}$ of its weight of lime. This solution is known as lime water, and is much employed both as a medicine and as a test for carbonic acid, which instantly renders it turbid, in consequence of the carbonate of lime that is formed being more insoluble even than the lime itself. It must, of course, be kept carefully guarded from the atmosphere, the carbonic acid of which would rapidly affect it. If in the preparation of slaked lime considerably more water is used than is necessary to form the hydrate, a white semi-fluid matter is produced, which is termed milk of lime. On allowing it to stand, there is a deposition of hydrate of lime, above which is lime water.

The following are the most important of the salts of lime:

Sulphate of lime (CaO,SO_3) occurs free from water in the mineral anhydrite, but is much more abundant in combination with two equivalents of water in selenite, and in the different varieties of gypsum and alabaster.

Carbonate of lime (CaO,CO_2) is abundantly present in both the inorganic and organic kingdoms. In the inorganic kingdom, it occurs in a crystalline form in Iceland spar, aragonite, and marble—in which it is found in minute granular crystals—while in the amorphous condition it forms the different varieties of limestone, chalk, etc. It is always present in the ashes of plants, but here it is, at all events, in part the result of the combustion of citrates, acetates, malatates, etc., of lime. It is the main constituent of the shells of crustaceans and mollusks, and occurs in considerable quantity in the bones of man and other vertebrates. Carbonate of lime, held in solution by free carbonic acid, is also present in most spring and river waters, and in sea water. Stalactites, stalagmites, tufa, and travertine are all composed of this salt, deposited from calcareous waters. Certain forms of carbonate of lime—the Portland and other oolities, some of the magnesian limestones, etc.—are of extreme value for building purposes, and the various uses of the finer marbles are too well known to require comment.

There is a combination of lime with an organic acid—namely, oxalate of lime—which is of great importance in pathology as a frequent constituent of urinary calculi and sediments.

The soluble salts of lime (or, more accurately speaking, of calcium) give no precipitate with ammonia, but yield a white precipitate (of carbonate of lime) with carbonate of potash or of soda. These reactions are, however, common to the salts of barium, strontium, and calcium. Solution of sulphate of lime produces no marked effect when added to a salt of calcium, but throws down a white sulphate with the other salts. The most delicate test for lime is oxalate of ammonia, which, even in very dilute neutral or alkaline solutions, throws down a white precipitate of oxalate of lime.

There are several compounds of phosphoric acid and lime of which the most important is the basic phosphate of lime, sometimes termed bone phosphate, from its being the chief ingredient of bones. The basic phosphate is represented by the formula $3CaO,PO_5$, and not only occurs in bones, but also in the minerals apatite and phosphorite, and in the rounded nodules termed coprolites, which are found in the Norfolk crag. It forms $\frac{4}{5}$ of the ash of well burned bone, the remaining $\frac{1}{5}$ being carbonate of lime. This ash is known as bone earth, and is employed as a manure and in the preparation of phosphorus, etc.

The uses of lime both in medicine and the arts are most extensive and valuable. Its employment in the preparation of mortars and cements, and for other building purposes, is too familiar to require notice here, and it is also largely used as a manure, in the purification of coal gas, in the manufacture of glass, in the preparation of hides for tanning, and in an infinite variety of chemical and laboratory processes, from its purifying effects and its power of attracting water.

In glass manufacture lime renders the glass harder and less soluble, and assists the fusion of the other materials. Brilliant table glassware is made from lime glass, and this oxide is also used in the manufacture of window and plate glass, which it helps to make impervious against the action of the weather.

Lime has been used for many centuries as a fertilizer of the soil. All crops require a certain amount, as is found by analyzing the ash which results from their combustion. It promotes the decomposition of all kinds of vegetable matter in the soil, and further, it corrects any acidity in the organic matter, and thus destroys those weeds which are favored by such a condition of the soil. It also assists in the decomposition of certain salts whose bases form the food of plants.

Lime is largely used in the materia medica. Quicklime, in association with potash, either as the *Potassa cum calce*, or as Vienna paste, is occasionally used as a caustic. Lime water, mixed with an equal quantity or an excess of milk, is one of our best remedies for the vomiting dependent on the irritability of the stomach. From half an ounce to two or three ounces may be thus taken three or four times a day. It is a valuable remedy for burns in connection with linseed oil. Chalk, or carbonate of lime, when freed from the impurities with which it is often associated, is used as a dusting powder in moist excoriations, ulcers, etc., and in the form of chalk mixture and compound powder of chalk is a popular remedy in various forms of diarrhœa.—*Glassware Reporter.*

ON A NEW CAMERA LUCIDA.*

By Dr. HUGO SCHRODER.

IN the recent volumes of the *Journal* of this society I have met with descriptions and figures of several forms of camera lucida which were new to me. I obtained an example of each, and made a series of trials in comparison with the older forms with which I was already familiar. In all of them I found more or less defects, such as limitation of field, distortion, indistinctness of image or of drawing point, awkwardness of position, etc. Being engaged later in endeavoring to simplify and perfect the construction and adjustment of Mr. Wenham's high power binocular prism, I was much interested by the ingenuity of this device, and it occurred to me that that arrangement of prisms might be modified, so as to be available as a camera lucida in which the defects of the forms hitherto made would be considerably reduced if not entirely eliminated.

Assuming a 45° inclination of the microscope to be the position most generally convenient for drawing, I (in June last) drew on a large scale the system of prisms which appeared to be suitable for a camera lucida. Messrs. Ross undertook to construct the prisms to my drawings, and the apparatus was found upon trial to answer my expectations fully. I am induced to describe it here because it has also met with much approbation from microscopists, who were previously disinclined to believe in the possibility of any new device at the present day which should be substantially better than the numerous older forms which apparently exhausted the subject!

It is well known that all forms of reflecting prisms acting by means of *one* reflection are extremely sensitive in regard to the position of the mirror in relation to the microscope, as also in a less degree in relation to the eye; the slightest deviation from the normal position in many cases entirely destroying the effectiveness of the apparatus. For this reason cameræ lucidæ acting by *one* reflection have not found favor, though their apparent simplicity has induced the construction of many such forms.

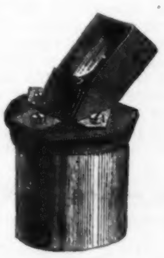
In order to obviate the difficulties incident to the use of *one* reflection, many devices have been made acting by *two* reflections; and where these have been so contrived as to act like parallel mirrors, the reflected image has possessed the advantage, peculiar to this principle, of being practically insensitive to slight differences of position relative to the microscope or to the eye, remaining in fact stationary within a considerable range of adjustment, as in Wollaston's camera lucida.

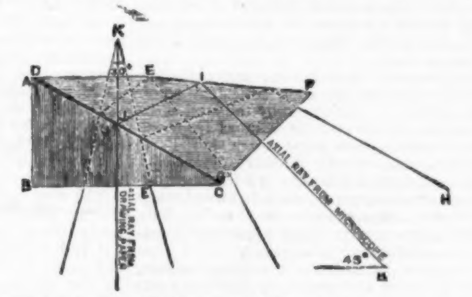
My device (Fig. 1) consists of a combination of a right-angled prism (Fig. 2), A B C, and a rhomboidal prism, D E F G, so arranged that when adjusted very nearly in contact—*i. e.*, separated by only a thin stratum of air—the faces B C and D E are parallel, and consequently between D E and B E' they act together as a thick parallel plate of glass through which the drawing paper is viewed. The rhomboidal prism is so constructed that when the face G F is applied at right angles to the optic axis of the microscope, the axial ray, H, passes without refraction to I on the internal face, E F, whence it is *totally* reflected to J, in the face, D G. At J a part of the ray is reflected to the eye by *ordinary* reflection in the direction J K, and a part transmitted to J' on the face, A C, of the right-angled prism. Of the latter a portion is also reflected to K by ordinary reflection at J'. The hypothenuse face, A C, is cut at such an angle that the reflection from J' coincides with that from J at the eye-point, K, thus utilizing the secondary reflection to strengthen the luminousness of the image. The angle at G is arranged so that the extreme marginal ray, H', from the field of the B eye-piece strikes upon D G at a point just beyond the angle of total reflection, the diffraction bands at the limiting angle being faintly discernible at this edge of the field. This angle gives the greatest amount of light by *ordinary* reflection short of *total* reflection.

By this arrangement the Ramsden circle over the eye-piece comes just above the camera lucida, and the field of view is not in any way reduced; all that can be seen directly through the B eye-piece (say 30° of field) is perfectly depicted in the camera lucida, while the drawing being viewed direct is of course not cut down in field.

In practice the microscope should be inclined about 45°, and the image accurately focused through the eye-piece as usual. The camera is then slid on the eye-piece and pushed down more or less until the microscopical image is seen distinctly and the illumination of the field is equal throughout. The drawing paper is placed on the table immediately under the camera. The observer will then see the microscopical image projected on the paper, at the same time viewing the pencil-point directly. The *whole* pupil of the eye is available for both images, the diaphragm on the apparatus being considerably larger than the pupil. It may be necessary to balance the illumination either by subduing the light in the microscope or by increasing it on the drawing-paper. It will generally be found that when the object is in a luminous field the light on the object (especially with lamplight) may be advantageously subdued by ground glass or similar means. The eye may be removed as often as required from the camera, and the work recommenced without the slightest shifting of the image; and, with properly balanced illumination, fully shaded drawings can be made with very little practice. The drawing-paper should in every case be placed at the distance of distinct vision, either using spectacles or not. If the vertical position of the microscope be preferred, the drawing-paper may be inclined 45°, either in front or at the side of the instrument. For very accurate drawings in all azimuths, the drawing-paper should, of course, wholly coincide with the plane of the optical image, as with every other form of camera lucida. A spring clip is provided in which a screen of black paper may be put to shade the eye not in use.

This form of camera lucida can be modified so as to project the image at any desired angle. It can be used with the dissecting microscope or hand-magnifier, also on a stand for architectural or mechanical drawings.





IMPROVED CAMERA LUCIDA.

* *Journal Royal Microscopical Society.*

PHOTOGRAPHING ON WOOD.

By J. TRAILL TAYLOR.

THIS subject is by far too comprehensive to be capable of being exhaustively treated in one or even two articles; but we shall, in the present one, clear the ground for what we shall write hereafter on this topic, and give the working details of one of the various methods successfully practiced for placing photographs on wood, either to remain there as their permanent resting place, or, what is of far greater importance, to serve as the drawing on which the wood engraver is to exercise his skill. It is in the latter direction that our remarks will tend.

Underlying the whole system of photographing upon wood is this principle—nothing must remain on the surface which is capable of clogging the point of the graver, hence the vehicle in which the composition of the photographic image is applied must be of the most attenuated nature possible. Again, it is easy to imbue the surface of the wood itself with the chemicals by which the image is formed, but difficult to prevent the wood that has been subjected to such treatment from becoming rotten or friable, by which fine, delicate lines crumble and give way under their construction, owing to the pulverulence of the surface. Firmness and closeness of texture are essential requisites in the surface that has to be operated on by the engraver.

Collodion, gelatine, starch, and other media have all been employed as vehicles, combined with silver salts of various kinds and chromates. Those processes known generically as "dusting on" have also conduced to the successful application of photography to wood, together with the simpler system of rubbing over the surface with a sensitive powder, made to adhere with sufficient tenacity to insure its not becoming dislodged by any after treatment—such powder being capable of being impressed by an image under the negative. This enumeration, incomplete as it intentionally is, serves to show how much ramified has become the important art of photographing on wood.

The first process which we shall describe is one involving the rendering of the wood sensitive with chloride of silver, without any rottenness arising. This we were assured of by an engraver for whom, ten years ago, we prepared two blocks which were engraved for a serial publication of the period.

The surface of the wood is first of all whitened by being well rubbed with a paste composed of finely powdered white lead and a little water. We have sometimes varied this procedure by the use of alcohol. When dry the surface receives a coating of an exceedingly weak solution of mastic and gutta percha in benzole. The following strength will suffice:

Gutta percha	3 grains.
Mastic	3 "
Benzole	1 ounce.

This does not leave any film on the wood, but serves merely to fix the white pigment.

The next operation is an unpleasant one, as it necessitates the working with albumen which, before being used, must have passed into a state of putridity. Beat into a froth the whites of as many eggs as may be found desirable, and for each egg employed add four grains of chloride of sodium and eighteen minims of strong ammonia. Keep this standing in a warm place for about a month, and add water to make up the loss from evaporation. When putrid, filter and apply to the surface of the wood by means of a brush. After being dried, apply, by the same means, a forty-five grain silver solution. The block, thus sensitized, is exposed under a reversed negative until printed sufficiently deep, after which it is washed by means of a broad camel's hair brush, and toned and fixed in the usual way.

At this stage we may introduce the method by which the negative may be used in a reversed position. Of course, when the negative is taken expressly for the purpose of being employed in connection with engraving, the photographer will take care that it be reversed or non-reversed to suit his special purpose; but in the case of pre-existing collodion negatives the case is different.

Let us suppose that a collodion negative several years old, and well varnished, is required to produce a reversed print. The first operation is to remove the varnish. This is best effected by pouring over the surface a little of the following mixture:

Caustic potash	2 parts.
Alcohol	2 "
Water	20 "

This must be poured off and on until the varnish is dissolved, when the surface is well washed with water and allowed to become dry. The plate is now placed on a leveling stand and coated with a very thin solution of India rubber in benzole, followed, after being dried, by a coating of transfer collodion composed of alcohol and ether, two pints of the former to one of the latter, in which is dissolved one ounce each of castor oil and gun-cotton. The object of the coating of rubber is to prevent the transfer collodion from acting upon the collodion that contains the image.

When the transfer collodion is quite dry, which may take one or even several hours, it is gently warmed to dispel any milkiness, should such exist. A knife is next run round the margin so as to cut through the film, and the negative is placed face upward in a flat vessel of water. Ere long the film will be seen to become loosened on the glass, and in a short time it will become altogether detached. It must then be placed between two sheets of blotting paper to be dried, after which it is kept in a folio for use.

In printing from a pellicular negative prepared as described, the picture may be either reversed or non-reversed according to the side placed next to the paper, and both classes of prints will be equally sharp.

We now describe a method by which the wet collodion process is applied to this purpose by a transfer system which does not injure the surface of the wood by the action of chemicals. Its practical nature may be deduced from the fact that it was by this agency the large portrait of Prof. Huxley, together with similar portraits of other eminent men of science, which appeared some time ago in a leading London illustrated newspaper, were placed upon the wood ready for the engraver. The process is mainly that of Grüne, subjected to such modifications as were found necessary in getting it brought to a successful state of working.

It is first of all necessary, by means of a copying camera, to produce from the negative a transparency the exact size which the engraving is required to be. The knowledge required to produce a transparency, together with a suitable camera for the purpose, is assumed as being in the possession of the operator. The collodion must be prepared with soluble cotton, made at a low temperature to insure its being tough or skinny, and it is so far fortunate that cotton of this class can be readily obtained throughout the United States, especially in New York. The mechanical characteristic of the collodion is that it shall be tough; its photographic peculiarity being that it shall not yield a dense image, but one that is very soft and transparent in even the deep blacks. The following is a formula which, we were informed by a professional photographer on wood, who is also a practical engraver, invariably gave the best results.

PLAIN COLLODION.

Alcohol	900 parts.
Ether	1,800 "
Pyroxyline	60 "

IODIZED COLLODION.

Plain collodion (as above)	700 parts.
Alcohol	450 "
Ether	150 "
Iodide of cadmium	14 "
Bromide of sodium	10 "
Alcohol	100 "

To dissolve the bromide of sodium, rub it in a mortar with a few drops of distilled water, then add the alcohol last mentioned in the formula, and finally the iodide of cadmium.

We have given the proportions in "parts," which any photographer may interpret by grains or drachms so as to suit his own idea as to the quantities desirable to be made at a time. But we must make one observation, which is this: It is necessary that the collodion be tough; but seeing that the longer a collodion is kept the less tough, or more rotten, it becomes, it is not desirable to make too large a quantity at a time.

The strength of the nitrate of silver bath should not exceed thirty grains to the ounce. The developer, too, must be somewhat weak, consisting of twelve grains of protosulphate of iron to the ounce of water, together with a drachm of acetic acid and a few drops of alcohol, although the latter may be omitted if the developer flows smoothly.

The glass on which the picture is to be taken should have a coating of a solution of a wax or paraffine in ether, which must be rubbed off with a dry cloth. This leaves a very thin film that facilitates the removal of the collodion at a later stage. In exposing, according to the side of the negative that is turned toward the lens, so will the subsequent transparency be reversed or not; and it need scarcely here be said that the image, when finally placed upon the wood block, must be reversed, so as to print direct after it is engraved.

It is impossible here to give data for exposing, as this must be determined by a few trials. It is better to employ a lens with a small stop, and give a liberal exposure, having the negative directed either to a uniformly lighted portion of sky or backed at some little distance by a white card inclined backward. When developed, the lights must be absolutely transparent, and there must not be a trace of fog observable on the picture; nay more, the whole picture must be so thin and transparent as to permit the details of the shadows to be plainly seen when the plate is laid face down upon a sheet of paper. After fixing with cyanide and washing, tone by the application of a solution of chloride of platinum, one grain to eight ounces, or of a strength sufficient to penetrate throughout the thickness to the image in about a minute. It is recommended to add tartaric acid to the platinum solution, in the proportion of five grains for each grain of the metallic salt. When toned, the transparency, without being allowed to become dry, must be placed in a bath of diluted sulphuric acid, one ounce of acid to a pint of water. This serves to detach the film from the glass.

But previous to the operation just described, the wood block must have been prepared. Place in a porcelain vessel eighty grains of Nelson's gelatine, or that of any other good maker, and cover it with cold water. Allow it to stand for two or three hours to absorb as much as it can; then drain off the superfluous water, and add ten ounces of warm water. If this does not cause the gelatine to dissolve, place the vessel near the fire, and it will speedily liquefy. Having rubbed up thirty grains of oxide of zinc in a mortar with a little water, add it to the gelatine, and filter through linen into a wide mouthed glass bottle. A few drops of carbolic acid will prevent decomposition, if it is to be kept any considerable time. Next apply to the surface of the wood a paste made of oxide of zinc and water, and rubbed by the palm of the hand, and then apply the gelatine by means of a broad camel's hair brush. This must be allowed to dry spontaneously.

Returning to the collodion picture in the acidulated water, it occasionally requires a little time, although sometimes only one or two minutes, to insure the film becoming quite detached from the glass. When this is the case, a sheet of stiff waxed or paraffined paper is introduced, and the film is lifted out of the water by its agency. An easy way of doing this is to operate in a deep wooden dish having a plugged hole in the bottom. Lay the sheet gently down upon the collodion film, still *in situ* on the glass plate, although not now adhering to it; then, by withdrawing the plug, let the water run off, thus enabling the glass plate with the collodion film and the paper to be removed without disturbance.

The surface of the wood having been made wet by drawing a broad camel's hair brush dipped in cold water over it, the paper, to which the film now adheres in preference to the glass, is gently lifted up from the latter, and superimposed on the wood block, collodion side down. A sheet of blotting paper is placed upon it, and over that a piece of rubber cloth, and moderately smart friction or pressure is applied to insure the attachment of the collodion to the gelatined surface of the wood. By means of a penknife the margin of the paper is then raised, and the sheet lifted from the block, to which the film now adheres. This adhesion is rendered more firm by placing the block for a few minutes in a warm place, sufficient to impart tackiness to the still wet gelatine by which it was sized. To prevent the wood from warping, at this stage the back of the block should be sponged with water. Some operators effect the required adhesion by holding the surface of the block to the fire for a few seconds. But care must be taken not to let the collodion become dry.

The next operation consists in removing the collodion and leaving the image remaining on the wood. This is expeditiously effected by pouring over the surface first a little alcohol, following this by ether. If a good quality of soluble cotton has been employed, the collodion quickly dissolves by the method described. The wood is not effected by either alcohol or ether. When dry, the block is ready for being placed in the hands of the engraver, or in those of the artist to have the details supplemented by a few pencil touches, or for the removal of portions not desired to be engraved.

Although the film of gelatine upon the wood is so thin as not to clog the point of the graver, it may be rendered still more attenuated by increasing the proportion of water in the gelatine solution.—*Photographic Times.*

THE DIRECT SYNTHESIS OF AMMONIA.

Mr. Stillingfleet Johnson has continued his researches upon the supposed existence of an active form of nitrogen which is capable of directly combining with hydrogen to form ammonia. He claims to have substantiated this discovery by a series of experiments with Grove's gas battery. The exact nature of these experiments need not be detailed here; but it may be stated that the results show that when nitrogen and hydrogen are suitably placed in relationship with each other, a considerable proportion of the two gases combines to form ammonia. The active agent in promoting this combination is the electrical effluve—*i. e.*, the silent and continuous discharge of electricity from an electrode. In Mr. Johnson's words, "Complete combination of nitrogen and hydrogen gases to form ammonia, with contraction of both gases, in proportions N_1 to H_3, may be effected by subjecting the nitrogen to the effluve while it is in contact with a platinized platinum plate." The practical value of this discovery, and the help it may afford in the direct synthesis of ammonia, are not as yet apparent.

THE DETECTION OF CARBON DISULPHIDE.

A process for the detection of carbon disulphide is described by M. Vitali in last month's *Journal de Pharmacie et de Chimie.* It consists in filling a gasholder with pure hydrogen, which is allowed to traverse a series of U-tubes filled with fragments of glass or pumice stone steeped in lead nitrate, silver nitrate, and caustic potash. For the same purpose, fragments of pumice steeped in sulphuric acid and in potassium permanganate may be used. The liquid in which carbon disulphide is to be sought is introduced into a three-necked bottle connected to a second bottle containing tartar emetic. A current of pure hydrogen is made to pass into the former, and thence into the latter. The hydrogen is then conducted into a chloride of calcium tube; after which it may be treated with reagents, or the products of its combustion may be examined. In a first trial, the gas is received in a few cubic centimeters of an alcoholic solution of caustic potash, to which are afterward added a small quantity of neutral ammonium molybdate and a very small excess of dilute sulphuric acid. If the liquid contains traces of carbon disulphide, it takes a rose color, which then passes to a vinous red. Another portion of the gas is passed into a small volume of an alcoholic solution of lead acetate, to which are added a few drops of caustic potash, and the mixture is heated to boiling point. If the mixture contains carbon disulphide, lead sulphide is produced. If the quantity of carbon disulphide is large, it becomes sensible to the smell. The flame has a blue center, and gives off the odor of burnt sulphur. It decolorizes blue starch paper; blue starch paper charged with iodic acid; and produces a yellow spot upon porcelain, which, if treated with caustic potash and then with sodium nitro-prusside or lead acetate, gives the reactions characteristic of the presence of sulphur. If a plate of silver is used instead of porcelain, there appears a black spot of silver sulphide. If there are dropped upon the porcelain plate solutions of caustic potash, of lead acetate, cadmium sulphate, antimony chloride, or arsenious acid, and the flame is allowed to spread over these points of the plate, the characteristic colors of the metallic sulphides appear. If the carbon disulphide is mixed in more or less considerable quantities with solid matters, they are divided as finely as possible, distilled along with water acidulated with sulphuric acid, and the distillate is further examined as above. If it is required to detect the carbon disulphide in illuminating gas, the gasholder is filled with the gas, and the process is conducted as described.

PURE HYDROSULPHURIC ACID GAS.

In precipitating arsenic from solution it is necessary to have sulphydric acid that is absolutely free from arsenic. Otto and Reuss recommend, for the preparation of this gas, the substitution of calcium sulphide for iron sulphide. The former may be prepared by heating gypsum and charcoal together at a high temperature. This is acted upon by pure acid free from arsenic. As no hydrogen is formed, any arsenical compound in the acid could not be reduced to arsenated hydrogen. To obtain a steady and quiet current of gas, large pieces of the calcium sulphide are placed in a Woulfe's bottle, a little water poured on it, and a 25 per cent. hydrochloric acid allowed to flow slowly from a funnel with stopcock, drop by drop.

Barium sulphide is also an excellent material for this purpose.—*Chemiker Zeitung.*

ACTION OF LIGHT UPON COLORS.

By M. Decaux.

The author refers first to the researches of Dufay and Hellot undertaken in order to classify the colors into fixed and fugitive, and expresses regret that the rules based upon this regulation have been permitted to fall into abeyance.

As regards the action of sunlight or diffused daylight upon colors fixed in dyeing, M. Decaux proves by a long series of comparative experiments that the shades dyed upon wool in the vat, with Prussian blue, cochineal, madder, weld, and even fustic, are much more permanent than those obtained with Nicholson blue, magenta, jaune d'or, and picric acid. Four of the coal tar colors differ from the rest of their class as regards stability, *i. e.*, the ponceau called naphthol carmine, orange No. 2, chrysoine, and artificial alizarin.

Colors for painting in water and in oils are divided into the absolutely permanent, the moderately permanent, and the fugitive. If used with water all the most beautiful reds, carmine, carmine-lake, most madder lakes, and vermilion, fall under the fugitive class. If mixed with oil, the madder lakes rank as moderately permanent.

The action of the arc light is similar to that of the sun, but has only one-fourth of the power.—*Bulletin de la Société d'Encouragement.*

ROCCELLINE.

Litmus or lacmus has long been employed as a test for the presence of acids, and so general is its use for that purpose that few dyes are so familiar to chemists. Like cudbear and archil, its source is the lichens which grow upon islands in the Atlantic, and it differs from these dye-stuffs chiefly because of the manner in which it is prepared. The process consists in subjecting the mass of gathered lichens, the principal of which is the *Roccella tinctoria*, to a species of fermentation, ammonia being added. The red coloring matter, orcin, is converted into a blue azo-pigment, which is separated, mixed with a sufficient quantity of gypsum and chalk to give it consistence, dried, cut into small cakes, and in that form sent into commerce. Its use is by no means confined to the dye-house. Being reddened even by dilute acids and restored to its blue color by weak alkaline solutions, it is constantly employed in chemical laboratories as a test for the presence of soluble acids and bases in excess, and for determining, by the failure of a mixture of an acid and a basic solution to effect the tint, that the mixture is neutral.

The French, who give to litmus the name *tournesol*, prepare a form of the dye on rags by steeping them repeatedly in the juice of *croton tinctoria*, and exposing them to the ammoniacal fumes given off by stable manure when undergoing fermentation. Although it appears to serve the purpose of the dyer equally well, the litmus on rags cannot, as a test, take the place of that from the roccella. It is employed to dye the peculiar kind of paper in which sugar-loaves come wrapped, and in Holland to tint the rind of certain sorts of cheese made in that country, and which, when externally dyed, is said to be less liable to mould and to be attacked by cheese-mites.

The discovery of the process of making roccelline artificially has been the natural outgrowth of the remarkable investigations of the last few years into the production and properties of the azo-compounds of naphthaline. After Mr. Z. Roussin, who in 1875–76 deposited a sealed packet in the French Academy, describing the process, thus establishing the priority of his discovery. Nitro-naphthaline is first treated with sulphuric acid. It is then reduced to the state of an amide and transformed into sulpho-naphthylamic acid. By the action of nitrous acid this is converted into the diazo form. Finally the solution after concentration is thrown into a solution of beta naphthol, from which roccelline is precipitated by common salt, washed, and purified by crystallization.

Like some other of the coal-tar colors, roccelline has more than fulfilled the expectation of its discoverer. Designed to replace the natural dye, it, as Mr. Emile Roussel has recently shown before the Societe Industrielle du Nord de la France, serves, under certain conditions, as a substitute for cochineal and madder in the production of shades of red and crimson. So far this is true of animal fiber only. On cotton roccelline has not been satisfactorily fixed. So great is the adhesion of the dye for wool that the rapidity with which it attaches itself is productive of a cloudiness over the surface of the fabric unless skillful hands be employed.

The following is the process: Slightly acidulate the dyebath with hydrochloric acid, raise the temperature to 50° C., enter the wool, and let it remain for fifteen to twenty minutes; then add roccelline little by little and raise temperature gradually during half an hour to 90° C. By maintaining

that temperature for half an hour the shade will then be completely fixed.

By adding chrysoine we obtained advantageously a shade which can replace that of madder; the economy in dyeing being about 50 per cent. Spots of ink and of iron-mould, which must be removed by oxalic acid before entering the goods into the madder bath, as it strikes a black with the least trace of iron, cause little trouble with roccelline, as salts of iron have no effect on it. As indicated above for chrysoine, other shades may be produced by substituting for it indigo-carmine, naphthol-yellow, or naphthol-orange, except that when indigo-carmine is used it should be added to the bath at the close of the process, and that sulphuric acid and sulphate of soda should also be added. The shades resist exposure to the air as well as those of cochineal, and incomparably better than those of archil. These two are made yellowish by acids, and reddish-violet by alkalies. Roccelline, on the contrary, preserves all its freshness of color in the presence of these reagents, while its cost is 80 per cent. less than that of cochineal, and 40 per cent. less than that of archil. For dyeing various grades of woolen upholstery goods, in which reds and kindred warm tints prevail, and when solidity of the dye is indispensable and cheapness desirable, artificial roccelline has already taken a foremost place.—*Textile Record.*

TESTING BARS AND PLATES OF METAL.

AT a recent meeting of the Institution of Civil Engineers the paper read was on "The Adoption of Standard Forms of Test-pieces for Bars and Plates," by Mr. William Hackney, B.Sc., Assoc. M.Inst. C.E.

The author said that in breaking test-pieces of the same quality of tough metal by direct tension, very different results were obtained according to the form of the test-piece employed. The sample that one engineer would define as stretching nearly 44 per cent., before fracture, was classed by another, using a test-piece of different form, as stretching less than 28 per cent. In fact, to obtain from any bar of metal relatively high percentages of ultimate stretching, all that was needed was to use short or thick test-pieces. Mr. J. Barba had shown, in a paper published in the *Memoires de la Societe des Ingenieurs Civils*, in 1880, that test-pieces of the same form—namely, in which the ratio of length to diameter was the same—gave the same percentage of ultimate stretching whatever their size might be; but that in those of equal length but differing in diameter, or of equal diameter but of different lengths, the percentages of ultimate stretching varied very much. Notwithstanding the extent to which the results obtained in testing a sample of ductile metal was thus affected by the proportions of the test-piece used, no standard dimensions or proportions for such pieces had been generally adopted; and those in common use varied very much. Sir Joseph Whitworth, for instance, advocated the use of a test-piece of 0·798 inch in diameter by 2 inches long, or 2·51 diameters long, and the test-piece in use at Woolwich Arsenal was 3·75 diameters in length. From these proportions the ratio of length to diameter was increased in the test-pieces adopted by different engineers, especially on the Continent, to 10 or even more. The ultimate stretching of test-pieces cut from the same bar of mild steel, similar in form at the ends, and of these different proportions, would be:

Ratio of length to diameter.	Ultimate stretching.
2·51	44·5 per cent.
3·75	37·5 "
10·00	28·2 "

The proportions of the strips, in which plates and flat bars were tested, had almost as great an influence on the percentages of ultimate stretching as had the proportions of cylindrical test-pieces; and those in general use varied nearly as much.

Mr. Barba showed that, in the case of pieces cut by a lathe or planing-machine from the same bar of metal, the law of similarity—that is to say, the law that test-pieces similar in form give the same percentage of ultimate extension, whatever their size—was as strictly true in the case of flat as in that of cylindrical test-pieces. The effect on the percentage of stretching of the transverse dimensions of an ordinary strip of plate or flat bar was not so great in the case of a cylindrical test-piece as in the strip. Whatever might be the width, the thickness remained always that of the piece of metal tested.

Test-strips of mild steel plates, 0·5 inch thick and about 1·4 inches wide, that stretched 27·5 per cent. in a length of 8 inches, stretched 37·3 per cent. if the measured portions were only 2 inches long; and in rather harder plates, which stretched 20 per cent. in a length of 8 inches, the extension in six inches was 25 per cent., and in 4 inches about 32 per cent. The test strips used at the Crewe Works of the London and North-Western Railway Company are only 2 inches long; and those employed in some tests of boiler-plates made at Sheerness Dockyard in 1875, and at Chatham Dockyard in 1879, were 4 inches long. But the length of test-strips adopted for plates, both in this century and abroad, is almost universally 8 inches.

The impossibility of comparing the results of tests made by different experimenters of the ultimate stretching of metals in the absence of standard forms of test-pieces, had long been felt by engineers, and had led to the adoption of several alternative methods of comparing their relative toughnesses. When a bar of ductile metal was stretched to breaking, it at first extended equally from end to end, with each successive increment of load, until the maximum load that it could carry had been reached; and up to this point the percentage of stretching was absolutely independent of the proportions of the test-piece used. This percentage of extension would thus appear to be the most important in comparing the structural values of metals, and to be that which should always be the most particularly noted. But practically testing in this way would be more tedious than the ordinary mode of loading the piece until it broke, and then measuring the elongation after fracture; so that in ordinary technical and commercial work this latter plan would always be preferred.

Another method that had been adopted to a considerable extent, for obtaining comparable measurements of the toughness of metals, without using test-pieces of uniform proportion, had been to measure not the linear stretching, but the percentage of contraction of area at the point of fracture. The practical objections, however, to this were, that contraction of area could be much less accurately measured than the increase in length; and that as a tough piece of metal often broke irregularly, it might be difficult to determine what its exact diameter at the point of fracture should be taken to be. Whether on account of difficulty of accurate measurement, or owing to the percentage of contraction of area not being exactly proportional to that of stretching, it was certain that the results by the two modes of measurement seldom precisely agreed.

A third mode of obtaining comparable results in testing by tension would be to use very long test-pieces, and to reject the percentages of stretching near to the point of fracture. But this would be expensive, and often inconvenient or even impracticable, and would not always give accurate results; for a long bar, when stretched to breaking, often began to draw down simultaneously in several parts of its length. The use of comparatively short test-pieces of some standard forms seemed thus to be the best method of making tests of the quality of bars and plates of ductile metal that could be employed.

In the testing of plates, the length of 8 inches was the only dimension of test-piece that appeared to be generally adopted; and as it was very desirable that the standard forms for cylindrical and for flat test-pieces should be such that the same metal might give the same percentage of stretching, whether tested in the one shape or in the other, this length, with a convenient width and an average thickness, might well be taken as the standard form, and that for cylindrical test-pieces be determined by experiment, so as to correspond with it.

The effect of hammering or rolling in increasing the toughness of metals was so marked, that in determining the shape of the cylindrical test-piece that would give the same percentage of ultimate stretching as the standard form adopted for plates, both shapes should be cut by lathe or planing-machine from the same bar, so that one might not be made from metal more drawn down than the other. This increase in the toughness of iron and steel explained the fact that in testing plates and rivet-bars, it was found that metal of the same quality stretched nearly as much in test-pieces of the same length, whether the bars and plates were thick or thin. The use of a test-piece 8 inches long was a more severe trial for a thinner than for a thicker plate; but the toughness of the former had been so much increased by the greater amount of rolling to which it had been subjected, that the one stretched before fracture nearly as much as the other.

As test-pieces similar in form had been found to give the same percentage of ultimate stretching, whatever their size, it might be better to define the standard cylindrical test-piece rather as being of a certain form than of a particular length.

This would facilitate the adoption of the same form by engineers of different countries using different units of measurement. In testing plates and bars such as rivet-bars, which were reduced to the size of the test-piece by hammering or rolling, it would be best to retain, as at present, one length of test-piece, whatever the transverse dimensions. In fixing the standard forms, the effect on the percentage of stretching of the distance from the datum points of the test-pieces of the shoulders or enlargements at the ends by which they were to be fixed in the testing machine, should never be overlooked. The enlargement might begin, for instance, half a diameter beyond each datum point, and its radius of curvature might also be half a diameter.

The whole subject of the testing of metals by tension seemed to be well worthy of consideration. If a uniform system of testing could be generally introduced, so that tests made by engineers in all parts of world might be directly comparable, the advantage would be very great.

POISONING FROM A LEECH BITE.

DR. GMEINER relates a case of fatal poisoning from a leech bite, occurring at Berne (*Journal de Medecine de Bruxelles*, vol. lxxvii., 1883). A man who was suffering from severe toothache, on the advice of a dentist applied a leech to the gums. After a couple of hours the pains increased and a slight inflammatory redness appeared on the lips, soon spreading over the neck and chest. The following day there was a swelling of the tissues about the head and face, and the patient had a high fever and dyspnœa. A few hours later he became delirious, had convulsions, and died the following night. The wound caused by the bite of the leech was of some size and black in color. The leech had been for a considerable time in the pharmacy where it was procured, and it was impossible to determine the nature of the poison from which the man died.

DIGESTIBILITY AND ASSIMILATION OF COW'S MILK.

PROF. UFFELMANN has recently given his results from an investigation of the above topic. His experiments were conducted upon adults and infants, and it appears that the latter possess an absorptive power somewhat greater than that of the grown man. His table presents the following figures:

Adult	absorbs	mean	90·5%	of total weight of	milk.
Infant	"	"	92·5%	"	"
Adult	"	"	98·4 to 99·7%	"	albumen.
Infant	"	"	98·2 to 99·2%	"	"
Adult	"	"	93·4 to 95·6%	"	fat
Infant	"	"	92·2 to 94·8%	"	"
Adult	"	"	90 to 91·7%	"	substances (solid).
Infant	"	"	90 to 94%	"	"

The infant hence absorbs less albumen and fatty materials than the man, but on the other hand makes it up in solid substances. The sugar is completely absorbed. As to the salts taken by themselves, the assimilation is represented for the adult by 44·2 to 56·6%, for the infant by 45·4 to 57%. For the salts of lime in particular, while the infant assimilates 75 to 78% of those contained in the milk of its mother, it absorbs only 25 to 30% of those contained in cow's milk, because in the first place the cow's milk holds a much larger amount, and in the second place the clots found in the infant's stomach are so much denser by this milk that they interfere with absorption. Some authors maintain that boiled milk, and especially milk cooked under pressure, is digested more easily than raw milk. Prof. Uffelmann's experiments contradict this entirely.

All bodies added to the milk which diminish the consistency of the clots increase its digestibility. The addition of water (one part milk to three of water) increases by almost 5% the proportion of peptones contained in the digested morsels.

Diluting with mucilaginous preparations assists this result more than water. The use of gum arabic is helpful, but as the acid of the gum is hurtful, it is necessary to add a small quantity of bicarbonate of soda.

The mixture of milk with the yolk of egg, according to the formula of Enko (milk ½ liter = ½ quart, water ¼ liter = ¼ quart; two yolks of eggs, milk sugar two teaspoonfuls; or else milk ½ liter = ½ quart, one yolk), is fairly good, though with young infants produces great flatulency. Lime water is only recommended in case of *excessive* acidity of the gastric juice.

Milk can be rendered more digestible by pepsin or pancreatine, but has a disagreeable odor and a bitter taste that sugar cannot hide.

Alcohol diluted, as for instance cognac, helps digestion, though it is not known exactly how, unless it stimulates the secretion of the glands.

THE ORIGIN OF THE CALIFORNIA COAST MOUNTAINS.

OBSERVING in your issue of Jan. 19th there is a difference of opinion on glacial action, and proof being always obscured and doubtful—nothing positive being adduced—I beg to intrude upon you my crude personal opinions on the early geological and climatic condition of our planet. This earth is colder to-day internally and atmospherically than at any time of its existence as a satellite to this our central sun. The earth's poles at one time were tropical and the equator was too hot to be inhabitable; that animal life first started in the polar regions. The internal heat was great, and the sun's power was possibly greater than now; frost was unknown. In time, by process of cooling then going on gradually, the long polar night, accelerating the cooling, prepared the way for vegetable and animal life; and at present date, with the impenetrable and increasing ice accumulations, animal life still clings to those (now inhospitable) regions. A long undisturbed development of life ensued. Then frost appeared, slight and transient at first. In time a winter appeared upon our planet. So long as frost was unknown in our polar region, the animal life, such as now or similar to it, existed and roamed over the polar regions. The equator was too hot for animal life, and vegetation, if it existed at all, was not as we know it now. After the lapse of ages winter became a fact and then lengthened and grew colder, and the summers cooler. Then animal life became migratory—some perished or fled at an epoch when a sudden advance of greater cold occurred. The sluggish bear, the prowling wolf, and other similar animals were fitted to remain, and fed on those that had perished, and they became acclimated to the change. The animals of a hot clime never seek a colder for a permanent home; for we have proof that animal life migrates to warmer localities, and if animal life did first start (exist) at the pole, all animals that remain there, migrate to, or seek for food there, are the remote descendants of that early life, and the long polar night was not inimical to their existence.

The earliest polar winters were obliterated by the summers, and the vegetation that had succumbed to frost was compensated by extending or encroaching toward the equator, which became cooler and in time favorable for the existence of life that was not of the salamandrine type. Then cool summers came, followed by severe winters. The ice packed, and possibly followed a cycle of mild winters and summers of greater heat; and the latent heat held within the earth's crust, combined with favorable climatic conditions, the ice pack or floe started southward; and these many recurring accumulations of ice and snow, and its dissolution by its displacement or movement south, are the cause which left on the earth traces of glacial action and rocks of the glacial epoch. Therefore, the glacial epoch was small at first, and after many growths and disappearances the ice of the poles became fixed, and is slowly but for a certainty encroaching upon the temperate zone. The temperate was once tropical, when the poles were temperate, and ultimately the tropic will become temperate; the temperate frigid, and animal life will be driven toward the equator, and the end will be, the higher organized animals that came into existence last will perish first, and life's exit will be as it began, for all must crystallize into death (cold). The proof of the above lies hidden beneath the polar ice and snow on land, in water. Could we behold the pole free of winter's garb, what a surprise of extinct flora and perhaps animal life would be revealed!

The night prowler and feeding animals, the night birds of passage, are of Arctic origin. There being no polar ocean around the north pole, but a continent, the quantity of animal life still in existence there is proof thereof. The descendants of these animals living around the pole have passed southward on either hemisphere, where many animals still show close resemblance to each other. The owl, fox, hare, deer, and numerous others are similar on either continent. In time these have varied under different climatic surroundings and changes—with enlarged geographical area separated by the Atlantic. The more their numbers increased the more diversified they became, and those entirely dissimilar—indigenous to either continent—are animals of more recent origin.

As our planet cooled the geographical area increased, giving greater and more varied extent for the development of life. The higher animals and primitive man possibly originated midway between pole and equator, and this fact gives him the power to survive and live in all climes; yet at his origin the surroundings were semi-tropical. The desire of man to avoid extremes, especially of cold, shows itself strongly, for fire and its uses become second nature to him. The rich, and many that are not, change their abode with the seasons, and successful emigration is but a change to the lower latitudes.

To determine the correctness of the above surmises, discontinue the misleading meteorological farce of stations high above large cities, with thermometers hanging to nails driven in chimney stacks, the hot air and the waste heat of thousands of fires in its immediate atmosphere. (Is it any wonder their thermometrical record never tallies with the out of door thermometers at private houses?) The city sites chosen are only fit for wind stations. The human race and the business of life are right down here on the earth's surface, and thereon should a record be kept of the daily heat of the sun and temperature of air and of the earth several feet below the surface; for if it be demonstrated indisputably that the earth cools one degree in so many years, we can approximate a time when the immediate crust on a given latitude will become so cold in winter that the heat of summer will not be powerful enough to sustain life, and the possible condition of this and all the other planets is determined inhabitable or otherwise by internal heat as much as by solar light and heat. This earth in its present form was never in a molten condition as a whole. It was possibly hurled into space when, say, two bodies came in contact in space—the force of the impact an intensely heated body (sun), our fragment hurled at a tangent out into space with myriads of other meteorites, larger or smaller, their velocity giving them their orbits, where the larger have gathered in the other fragments (meteorites) on their path or were impinged by those revolving perpendicular to their orbits. Thus the planets nearest to the sun, completing the quickest revolutions, have the clearest path, perfecting their growth and advancing

on to decay (cold). If this is so, then the outer planets are still subject to violent, sudden meteorite addition to their bulk, producing intense internal heat—all vapor at boiling point, their metallic substance red hot and molten where the plunging meteors entered deep into the interior—producing fearful explosions, and many years hence the cooling process expelling the heat by violent earthquakes. Those recently disturbing our earth may be the result of huge meteors ages since driven far into the earth's interior, the heat resulting therefrom penetrating the earth and radiating from center to surface.

OBSERVER.

Houston, Texas Co., Mo., February 14, 1884.

STANDARD TIME.

THE 18th of November, 1883, is a date that will long be remembered, from the fact that upon that day one of the most important and radical changes in the time standard of the United States and Territories was adopted. Our great commercial interests had long felt the want of better and more uniform time for this country for their railways; but its wide expanse, from east to west, covering 60 degrees of longitude, with a difference of four hours in time between the Atlantic and Pacific coasts, seemed to offer almost unsurmountable difficulties. We have now to thank the ingenuity of such persistent scientists as Prof. Chas. F. Dowd, of Saratoga, N. Y., Prof. H. A. Newton, and Dr. Leonard, of New Haven, Conn., and the liberal as well as practical railroad interests of the country, for a most satisfactory solution of all difficulties, and for giving to America the best time and the best standard now known for keeping it. The excellent map with which we illustrate this page was made and first published by the Tribune Company of this city. The different shades on the map represent an hour of time and 15 degrees of longitude. The standard of this system is that of Greenwich Observatory; hence, the 60th degree of longitude not shown on this map is four hours slower than Greenwich time; the 75th, five hours slower; the 90th, six hours; the 105th, seven hours: and the 120th, eight hours—thus making five different standards between the Atlantic and Pacific oceans. These five standards are shown on the map in the order just mentioned, viz.: Intercolonial, Eastern, Central, Mountain, and Pacific time. The 90th meridian, on which Central time is based, is nine minutes slower than Chicago solar time. The 75th meridian, which gives Eastern time, is one hour faster than Central time, or four minutes slower than New York city solar time. Intercolonial time being based upon the 60th meridian, is two hours faster than the Central time. Mountain time, which is based upon the 105th meridian, is one hour slower than Central time. Pacific time is two hours slower than Central.

STANDARD TIME.

The several meridians are indicated upon the map, as well as the territory included in the different divisions. The irregularity in the boundaries is caused by the various roads wishing to adopt as their standard the time of the meridian nearest to which the greater number of their lines are situated.

STANDARD TIME FIGHTERS.

THE following extract from the *Boston Herald* of Jan. 9, 1884, printed herewith, details the situation in Bangor:

"The Mayor of Bangor continues to display the courage of his convictions. He started out two months ago to fight the standard time, and prevented its adoption in Bangor, where, to be sure, it makes more difference than it does here. The community is divided upon the subject. Last week the City Council voted to adopt the standard time for one of the public clocks, as prayed for by those taking their time from it. But Mayor Cummings vetoed the order. He declares that neither railroad laws nor municipal regulation has power to change one of the immutable laws of God, that the hours of noon, sunrise, and sunset should occur at different periods of the day at different localities upon the earth's surface. So this 'farce styled standard time' he vetoes on the ground that it 'is not indorsed by one-fourth of the general public, as it does manifest injustice to all laborers and mechanics, or others who labor 10 hours per day, as it turns day into night, as it teaches wholesale falsehood and deception, and is in no way adapted to the wants of the general public, for whose interest all legislation is or should be; and last of all, as only 16 persons out of 16,000 or 17,000 ask for it.' Outside of Bangor we know of very few New England people who sympathize with its stiff-necked Mayor. He might get some aid and comfort by conferring with the pastor of the Berkeley Street Congregational Church in this city, who also opposes the standard time on the ground that it is a lie."

The man whose conscience smites him for not keeping his watch running on "true" time is in a bad way. It is the worst case of total depravity on record. Cain's feelings as narrated in Genesis must be trifling compared with the feelings of such a man. Cain did one foul deed, but the local time man, if his feelings are governed by the sin on his conscience, must be in a perfectly terrific frame of mind. Only when he is asleep in bed can he consider himself moderately sinless, and not even then should he chance to turn over and rest on a different spot. For a lie is a lie, be it big or little. Midshipman Easy's nurse, to be sure, made the excuse for herself that it was "such a little one," and perhaps our local time man endeavors to solace himself in the same way, but it won't do. Supposing his watch to be set with perfect accuracy on mean solar time at the point upon which he rests before he rises in the morning (his center of gravity or gyration must be definitely ascertained for this purpose), every time he moves 1,000 ft. east or west he must change his watch one second, or its time lies to that extent. It follows that for every 100 ft. it lies one-tenth of a second, for every 10 ft. it lies one-hundredth of a second, for every foot one-thousandth of a second, and for every inch one twelve-thousandth of a second. To be sure, it is "such a little one," but so was Sarah's. Even such fractions would equal years in astronomical calculations.

Moreover, if he stands as motionless as Bartholdi's Statue of Liberty, he lies in spite of himself if he believes in the literal meaning of the text that the sun was set to "rule the day." No watch has ever been invented that will keep *true* solar time. It follows, therefore, that "mean solar time" is an arbitrary standard after all, and the only question for individuals to decide is which standard is the most convenient for use. The few individuals who prefer "mean local time" have of course a right to indulge the idiosyncrasies of their own minds, but their experience will be somewhat like that of the juryman in having to deal with forty or fifty millions of obstinate people who disagree with him.

Why should not our local time friends govern themselves by the latter part of the text above referred to, which says that the sun was set to rule the day, and the *moon* to rule the night. If they should conform to the latter literally, we do not see how they can logically escape doing so. It would be but a trifling aggravation of a mild and harmless form of lunacy after all.—*Official Guide.*

MANUFACTURE OF POROUS EARTHENWARE BY MEANS OF NAPHTHALINE.

M. STEIN works up the naphthaline into an emulsion of water, or comminutes it in any other convenient manner, and mixes it with the slip. The articles moulded are dried; and then heated sufficiently to expel the naphthaline by exudation or distillation. It is collected for reusing, and the earthenware is then burnt in the ordinary manner.—*Cosmos les Mondes.*

A CENTURY OF BALLOONING.

A HUNDRED years have passed since the modern art of aerial navigation, by the aid of a supporting buoyant globe filled with heated air or some gas lighter than the atmosphere, began to be practiced. In 1783, the brothers Stephen and Joseph Montgolfier, sons of a paper maker of Annonay, near Lyons, found, during a course of experiments they had been conducting, that air heated to a temperature of 180 deg. loses half its weight, or in other words becomes half as light again as the ordinary atmosphere. From this discovery rose the balloon, the Montgolfier fire-balloon as it has ever since been called, in distinction to the Charliere or inflammable gas (hydrogen) balloon invented in the same year by M. Charles. To this latter gentleman is due the employment of the gas balloon as we now have it, for though Mr. Green was the first aeronaut to substitute carbureted hydrogen, or the ordinary coal gas, for the more expensive, though lighter, hydrogen employed by M. Charles, still, as Mr. Hatton Turnor points out in his admirably compiled "Astra Castra," to the French scientist is due the complete creation of the "*appareil*" of aerostation, the valve, car, and its supporting ropes, the ballast to regulate, and the barometer to measure ascent and descent, and the varnish that renders the silk impermeable. All these ingenious contrivances were used by M. Charles on his first ascent. "Since then," says Mr. Turnor, "nothing has been changed, little has been added," which may be taken as an epitome of the progress of balloon building and fitting during the past century.

The first Montgolfiers, made of paper or fine linen, and elaborately decorated, were inflated over a fire fed with bundles of chopped straw. When released they would occasionally rise to 6,000 feet, but in ten minutes the heated air within them became reduced to the outer temperature, and they generally fell within a mile or two of the place from which they had ascended. The fate of M. Charles' pioneer silk balloon, inflated with hydrogen, is curious, as foreshadowing that disaster which from then till now has been more or less attendant upon ballooning enterprise. At the signal from a gun the Charliere, 13 feet in diameter, which had taken days to inflate, and had been carried to the Champ de Mars, ascended in the presence of a vast concourse of people. Despite the heavy rain, it rose to over 3,000 feet, and having remained in the sky some three-quarters of an hour, fell in a field near the village of Gonesse. The alarm of the inhabitants is thus described: "On first sight, it was supposed by many to have come from another world. Many flee; others, more sensible, think it a monstrous bird. After it has alighted, there is yet motion in it from the gas it contains. A small crowd gains courage from numbers, and for an hour approaches by gradual steps, hoping, meanwhile, the monster will take flight. At length one bolder than the rest takes his gun, stalks carefully to within shot, fires, witnesses the monster shrink, gives a shout, and the crowd rushes in with flails and pitchforks. One tears what he thinks to be the skin, and causes a poisonous stench; again all retire. Shame, no doubt, now urges them on, and they tie the cause of alarm to a horse's tail, who gallops across the country tearing it to shreds." In the large towns of France, however, and particularly in Paris and Lyons, the new invention was regarded with high favor by both the nobility and people. Already the advertisement of a Montgolfier or Charliere balloon ascent, though nothing more interesting was carried to the skies than some pigeons or a sheep, would draw together a vast concourse of people. But when, in January, 1784, it became known that the largest aerostat hitherto launched was being put together in the suburbs of Les Brotteaux at Lyons, and that it was the intention of seven gentlemen to ascend in it, the multitude that flocked to the banks of the Rhone is described as having been prodigious. The Montgolfier, which was inflated from a straw pile in seventeen minutes, had a cubic capacity of over 500,000 cubic feet, was 100 feet in diameter, and about 130

1. Montgolfier fire-balloon. 2. Mrs. Sage, first English Lady aeronaut. 3. Vincent Lunardi, first aerial traveler in England. 4. M. Charles, inventor of the gas balloon. 5. J. P. Blanchard, first crossed the Channel in a balloon, Jan. 7, 1785. 6. Mr. Sadler, first English aeronaut. 7. First ascent from Lyons, Jan. 19, 1784. 8. Mr. Henry Coxwell. 9. Perilous situation of Major Money, July 23, 1785. 10. Balloon mistaken for a monstrous animal by the villagers of Gonesse, near Paris. 11. Mr. Charles Green. 12. Green's night voyage to Nassau. 13. Car of Nadar's balloon, "Le Geant." 14. Mr. Cocking's parachute. 15. The two Montgolfiers. 16. Mr. James Glashier, F. R. S. 17. Pilatre de Rozier, first aeronaut, killed in 1785.

18.) EXPERIMENTAL FLYING MACHINES.

A. Julian's Aerostat. This machine, made in a model, 25 feet in length, moved by clockwork, succeeded in the experiment made at the Hippodrome at Paris.

B. November, 1851. Aerial scheme of Mr. Helle not yet tried; consisting of a combination of sails and screws, which were to have been moved by the strength of two men.

C. The Aerial ship l'Aigle, of Mr. Lennox. It proved a failure in the Champ de Mars, August, 1834.

D. Flying Balloon made by an engineer named Blainville. It is not explained how these wings were to be used; but it gives the idea of weighting and lightening a balloon with air by means of a pump.

E. Systeme Petin, 1850.

F. An anonymous idea.

G. A balloon with a reversed parachute by M. Henin. This parachute was to slacken the ascent of the balloon, and allow the action of the wind on the sails, thereby guiding it at pleasure.

H. Sir George Cayley's Navigable Balloon, 1816.

I. Samson's Aerostat, furnished with fins made of feathers: like Julien's, a motive power is required

ILLUSTRATIONS OF THE CENTENARY OF BALLOONING.

feet in height. On Jan. 19 the ascent of this balloon was successfully accomplished by M. Pilatre de Rozier, the first aeronaut and the first aerial voyager to meet his death, and accompanying him were Joseph Montgolfier, Count de Laurencein, Count de Dampierre, Prince Charles de Ligne, Count de Laport d'Anglefort, and M Fontaine. Aerial navigation was deemed an accomplished fact, and the rapid abolition of ships and stages was already confidently predicted. In that year, 1784, as many as fifty-two ascents were made. The science of aerostation spread from France to Italy and England. On May 2 ladies were carried into the air for the first time at Paris, and June 4 witnessed Madame Thible's aerial voyage. Sept. 15 inaugurated ballooning in England, when Vincent Lunardi ascended successfully from the Royal Artillery Ground at Finsbury; and two months later Mr. Sadler, the first English aeronaut, was equally fortunate in his attempt made from Oxford.

The year 1785 is memorable in the history of ballooning by reason of two events. On January the first occurred, when the Channel was safely crossed for the first time, from Dover to Calais, by the celebrated French aeronaut, M. Blanchard, accompanied by Dr. Jeffries. It was a hazardous enterprise, rendered doubly so by the smallness of the balloon employed, which was so deficient in buoyancy that it was with the greatest difficulty the car could be kept above the level of the sea, so that to prevent dropping into the waves the balloon had to be lightened of every superfluous pound, even to the aeronauts' clothes, which were hastily stripped, and thrown overboard. Luckily, as they neared the French coast, the balloon rose, and, describing a magnificent arc, carried them over the high ground surrounding Calais, and finally landed them in the forest of Guines. The triumph of M. Blanchard led five months later to the first fatalities in connection with aerostation. On June 15, M. Pilatre de Rozier and M. Romain left the ground at Boulogne with the determination of reversing the achievement of January. The machine employed was a novel one, composed of a Montgolfier, having a small Charliere overhead. Thirty minutes elapsed since they had left the earth, when the S.E. current that carried them out to sea had changed to S.W., and brought them back inland. Suddenly a cry arose from thousands of spectators more sudden than any that had ever emanated from so large a multitude, for at the same instant all beheld the machine in flames, and after many swift wave like motions it fell a shapeless mass upon the ground, on reaching which the unfortunate aeronauts were found to be dead. Since the days of the Rozier disaster many successful and unsuccessful attempts have been made to fly the Channel; the more fortunate being those of Green, Coxwell, Colonel Burnaby, and Mr. Simmons, while among the conspicuous failures may be mentioned the recent efforts of De Fonvielle. In an endeavor to cross the Irish Channel in October, 1811, Mr. Sadler had a narrow escape from drowning, and was only rescued from the waves in the last stage of exhaustion, yet still clinging to the netting of his wrecked balloon, from which he received support, by the time aid of the Douglas herring fisher Victory. Again, as far back as July, 1785, Major Money, one of the earliest and most enthusiastic advocates for the employment of balloons in warfare, was blown out to sea from Norwich, and fell into the water twenty miles from Lowestoft. His perilous position was made the subject of a picture by Rinagle, R.A., a reproduction of which appears in the center of our illustrations.

But to return to the progress of ballooning. The commencement of the present century is closely associated with the name of M. Garnerin, the inventor of the parachute, and replaces that of M. Blanchard. In June, 1802, Garnerin and Captain Snowden performed the journey from London to Colchester (sixty miles) in forty-five minutes. In July the intrepid Frenchman ascended from Marylebone to the then unheard of height of 7,800 feet; an achievement which he subsequently capped by attaining, on Sept. 21, an altitude of 10,000 feet and descending in a parachute. The parachute, or machines like umbrellas used to break a fall from high places, are said to have been used in Siam full two centuries since. But in Europe the first experiment with such a contrivance was made in Paris in 1783, when a certain M. Le Normand had the hardihood to leap from the window of a house holding a wide-spreading "Gingham" of some thirty inches in diameter in his hand. Contrary to one's expectation, there was no accident attendant on this singular exhibition. Fifty-four years later, Cocking sacrificed his life through what he could not be dissuaded from considering was an improvement on the accepted parachute principle. His invention was in the shape of an umbrella reversed, 34 ft. in diameter, and kept open by a hoop of hollow tin. The machine was taken up suspended from Mr. Green's Nassau balloon, and was liberated by Cocking (Mr. Green obstinately refused to cut him away, having all along doubted the stability of the metal hoop to stand the pressure of the air), when over Greenwich, at a height of 5,000 feet. The parachute for a few seconds descended very rapidly, when the rim giving way, as Mr. Green had foreseen, the apparatus collapsed, and Mr. Cocking fell into a field at Lee and was dashed to pieces.

In 1803 Count Zambeccari (subsequently killed through leaping from a burning Montgolfier in 1812), Dr. Grassati, of Rome, and M Pascal Andreoli, of Ancona, inaugurated the first of those remarkable scientific ascents which have been so courageously continued down to our own time by Biot, Gay-Lussac, Wise, and Glaisher. In 1817 Mr. Windham Sadler, son of the first English aeronaut, succeeded in accomplishing that in which his father had failed, and successfully crossed the Irish Channel. Later, in 1824, in an ascent from Blackburn, the balloon struck against a chimney and Mr. Sadler fell over the side of the car and was killed. In 1819 Madame Blanchard came to a tragical end, when her balloon took fire, and she fell enveloped in a sheet of flame. Mr. Green and Mr. Wise, the American, were just then bent upon testing the capabilities of balloons for long voyages. Count Lennox, Mr. Holland, M.P., and Mr. Mark Mason were at this period the leading patrons of aeronauts, the latter especially being an earnest inquirer into the possibilities of directing a balloon. To the enterprise of Mr. Holland was due the most remarkable ascent of the century. Mr. Green was, as every one knows, the professional aeronaut employed for the historic voyage from London to Weilburg, in Nassau. His balloon, after this unparalleled achievement, was christened after the German Duchy in which it safely descended; and to this day is as famous as when, after a journey of eighteen hours, during which 500 miles were traversed, Messrs. Holland, Mason, and Green set foot on German soil, having ascended from Vauxhall Gardens the previous afternoon, Nov. 7, 1836. The career of Green began in 1821, at the coronation of George IV.; it continued for thirty-six years, during which he made no less than 1,400 ascents. He died in 1870, in his eighty-sixth year. To him are due, besides the introduction of coal gas for inflating, many improvements in the general management of balloons. His guide rope has been found particularly useful in crossing the seas. Mr. Coxwell, on whom the mantle of Mr. Green has apparently descended, entered upon the hazardous career of an aeronaut as an amateur about 1844. It was not until 1848 that he commenced professionally as the successor of Mr. Green. His name will always remain associated with that of Mr. Glashier on account of the series of scientific ascents made by them during the years 1862-3. M. Nadar, the constructor of the largest gas balloon ever made, and an enthusiastic student of the science of aerostation, must not be omitted from this article. In 1863, the building of Le Geant, capable of containing 200,000 cubic feet of gas, was a new departure in construction, particularly as regards the car, which was shaped after a cottage, 8 ft. high, 13 ft. long, and containing two stories, divided into printing office, photographic department, lavatory, etc. On its first ascent Le Geant took up thirteen persons, but beyond accomplishing a journey of 400 miles to Nienburg, in Hanover, no special results were gained.

That the balloon has been of some advantage to science is certain, but that it has answered its earliest expectations, and given us a means by which controllable aerial transit could be effected, cannot be claimed for it. Among our illustrations are those of a variety of different contrivances for guiding or propelling a balloon in a desired direction, which have all proved unsuccessful.—*Illustrated London News.*

RACING ON SNOW SHOES IN SWEDEN.

In former times, when railroads were quite scarce in Norway and Sweden, snow shoes were used quite extensively, as no other means were available for crossing the enormous snow fields in these countries. In 1830 the Norwegian army corps was dissolved which was formerly exercised and drilled in the use of snow shoes. The Norwegian snow shoe, or ski, is made of a board about 2 to 3 yards long, 2 to 3 inches wide, and 1½ to 2 inches thick; they are bent upward like a sleigh runner at the front end.

With the snow shoes the snow shoe stick, or "ski stick," is used, which consists of a long pole, provided at a short distance from the lower end with a disk which prevents it from being forced too far into the snow.

RACING ON SNOW SHOES IN SWEDEN.

The annexed cut, taken from the *Illustrirte Zeitung*, represents a snow shoe race by students on the Schlossberg at Upsala.

SWEET ENSILAGE.

Sweet ensilage is something that is talked of, but seldom seen. Mr. Goffart, of France, who first brought the subject of curing green fodder in silos to the attention of modern agriculturists, claims that his own ensilage is perfectly sweet. Dr. Drew, of Vermont, told the farmers at the St. Johnsbury meeting that his ears of corn came out of the silo perfectly sweet, but, upon cross questioning, changed his statement by saying that it was sweet in that it was not fermenting or putrefying, but that it was somewhat acid to the taste.

Prof. Miles has been conducting certain experiments at the Massachusetts State College, with the purpose of finding out the true cause of the acidity found in nearly all ensilage, and in a lecture recently given at Worcester gave some account of the results of his investigations. By inserting a gas pipe into the ensilage of a silo, observations were carried on for a period of over three months. The temperature the day the cover was put on stood at 82° F., and at the end of eight days ran up to 87°, from which it gradually fell in three months to 49°. On the second day after putting on the cover the ensilage was found swarming with bacteria, which were remarkably active and rapidly increasing by self-division. After the first few days the indications of rapid reproduction were not as marked, but the activity of the bacteria was not sensibly diminished until the temperature had fallen below 60°, about forty days after the silo was filled. These bacteria or ferments, as has been apparently proved by Pasteur, are capable of carrying on the functions of nutrition and assimilation with great activity when deprived of free oxygen in the air, taking oxygen from the substances upon which they feed.

When the life of the bacteria is destroyed, the process of putrefaction or fermentation ceases, and this takes place, according to observations made, at a temperature of from 122° to 140°, and if the germs that produce the bacteria are then excluded, the process of fermentation or of putrefaction cannot again take place. An illustration of this is shown by our methods of preserving fruits by heating to kill germs, and then sealing air tight to keep fresh germs from getting to the fruit.

Prof. Miles believes that if the bacteria can be destroyed when the silo is covered and weighted, the ensilage will be preserved absolutely sweet, like the fruits in our sealed jars. The practical question now presented is, how to kill the bacteria. The experiments thus far carried on make it probable that a temperature of from 115° to 122°, maintained for a period of only a few hours, will be sufficient for this purpose, though the germs might require a longer period of heat to destroy them. The Professor would therefore let the filling go on slowly without much tramping, so that the temperature would reach 115° or 122° before putting on the covers. The heat would then probably be maintained long enough to destroy all bacteria and bacteria germs, and then the ensilage may be expected to come out perfectly sweet.

A single case is reported where close observations of the temperature have been made, and with *sweet* ensilage, resulting from a temperature of 132°. Prof. Miles is quite confident that the right track has been struck in studying this matter, and that only further experiments are needed for determining the exact temperature that the ensilage may be allowed to reach before covering and weighting.—*N. E. Farmer.*

GEESE.

Americans are not such goose eaters as the people of Europe. The turkey has in a measure supplanted the goose on all great holidays and festivities. The goose, however, is still highly prized by many, and when happy Christmas and New Year come around it is found upon the family board, and some prefer it to turkey for "Auld lang syne" memory. Considering the extent of our country, the rivers and streams which flow through our lands, the pasture range everywhere, and the locations contiguous to good city markets, it is somewhat strange that so few geese are raised on farms, compared to the large number of barnyard fowls. No class of poultry will give the breeder more profit on the investment than geese, where the facilities are at hand and the location for their propagation good. Geese will take better care of themselves upon an old pasture range where a stream or pond runs through, keep in better condition upon grass, on the floating garbage by the lands, in the muddy pools and by the shores than will any other species of domestic poultry.—*Poultry Monthly.*

QUINCE CULTURE.

The quince is a gross feeder, as is indicated by the multitude of its fibrous roots interlacing and grasping every portion of the soil in its vicinity. It delights in hollows that have received the wash of fertilizing matters from higher grounds, nature's pockets, that have been storing up fertility for ages, and from this fact came the mistaken idea that the quince should be set in low, wet places, and it is often planted where water stands the greater part of the year. In such situations no fruit tree will continue to thrive.

I have had as good success with quinces set in upland that is quite dry, but in good condition of tillage and fertility, as with those set in moist, heavy soil, each receiving the same treatment. This fact has caused remark from many visitors. The injury done the quince by over-fertilizing is greater than is liable to occur to almost any other fruit tree, as in very rich soils, or when abundantly supplied with stimulating manures, its growth is excessive, to the exclusion of fruit-spurs, and the rank, succulent growth continuing until the approach of winter, must receive injury from freezing, producing blight the ensuing season.

In rich soils cultivation should cease after July, and any shoots of excessive growth should be pinched. A moderate quantity of fertilizer annually supplied to soil of fair condition is all that is required. Leaf mould, muck, sods, mud from ponds, form a safe and lasting dressing for the quince; it need not necessarily be incorporated with the soil, for

when placed about the stems, new roots will be sent out to forage throughout the mass. An orchard so treated will long continue in health and productiveness.

When propagated by cuttings, strong shoots of the current year's growth are cut in the fall to one foot in length, having a bud close to the base, and the whole space between buds left on above the top bud. Bury in bundles below frost, and in early spring plant in trenches in rich, moist soil, sticking the cuttings at a slant of from 15° to 60°, so that the top bud will be even with the surface of the soil; stamp firm at the base and cover with one inch of sawdust or other light material, as a mulch.—*N. Y. Tribune.*

THE CABBAGE PLUTELLA.

(*Plutella cruciferarum** Zell. Order *Lepidoptera;* Family *Tineidæ.*)

PAST HISTORY.

INASMUCH as this insect has been known to entomologists in this country for the last thirty years, it is strange that its presence has been scarcely noticed by farmers and gardeners, though it has done considerable damage to cabbages from time to time. This silence may, however, partly be due to the small size and agility of the worms, or partly to the circumstance that they somewhat resemble the younger stages of the larvæ of the different species of the white cabbage butterflies of which we have just treated.

The first account of this insect was given by Dr. Fitch (see his first New York Report, 170, 1855), who observed it in the neighborhood of Ottawa, Ill., in October of 1854, where some of the gardens were so much infested that all the outer leaves of the cabbages were literally riddled with holes and more than half of their substance eaten away. From 1855 until 1870 scarcely anything was heard or written about its ravages, until it was again noticed in the autumn of 1870 by Dr. A. S. Packard, Jr., as quite abundant on the leaves of cabbages on the Agricultural College grounds at Amherst, Mass. The same year, according to Dr. Packard, the same insect did great damage in some parts of Michigan. It was also reported in 1870 to Prof. T. Glover as plentiful and inflicting serious damage to cabbages in parts of Maryland, and the following year its ravages were reported from New York and New Jersey. Since then nothing has been published that we are aware of, but our experience shows that the insect has steadily increased and has spread over nearly the whole section of country east of the Rocky Mountains, being found in all the Atlantic States as far south as Florida, as far north as Michigan, and one specimen was even taken by Mr. V. T. Chambers, near Berthoud's Pass, in Colorado, at an altitude of about 11,000 feet.

HABITS AND NATURAL HISTORY.

This insect may at any time become one of the most troublesome species with which gardeners will have to contend, as it not only feeds upon cabbage, but is equally injurious to the leaves of the different kinds of turnips and other Cruciferæ. Its larva was found by Mr. A. Bolter, Chicago, Ill., feeding upon the leaves of the wall flower (*Cheiranthus cheiri*), and also of stock (*Matthiola annua*), from December to February, in greenhouses. Only the expanded outer leaves of the cabbage are injured by the insect, the compact inner head being left untouched, but in those varieties which do not form large and compact heads the cabbage is utterly ruined. The larva is very active, wriggling violently when disturbed, and falling suspended by a silken thread. It is pale green in color, a little over a quarter of an inch in length (nearly 10 mm.), and is nearly cylindrical in shape. When ready to pupate it forms for itself a beautiful, delicate, gauze-like cocoon, the meshes of which are so wide that it resembles lace, and through which the inclosed pupa can plainly be seen.

Fitch states that it is destroyed by an ichneumonid parasite, which, however, he does not attempt to describe. From his description of its cocoon it seems to belong to Microplitis. We have also bred *Limneria annulipes* Cresson from the pupa of this species. It will be unnecessary to give detailed descriptions of the early states, as Fitch has already given them with sufficient minuteness. The winged insect is of an ash-gray color, with an expanse of wings of about 15 mm. The male and female are often taken for two distinct species, and there is much individual variation, many of the specimens we have bred being uniformly colored, without trace of the pale costal marks. There are probably two broods a year in the more northern States, and three or more farther south. The insect hibernates in the pupa state. The egg has not been observed.

The following item from the Trans. Linn. Soc., New South Wales, quoted in the *Zoologischer Anzeiger* July 9, 1883, undoubtedly refers to this species:

"Mr. Macleay exhibited specimens of a small moth (*Tineida*) the larva of which was at present creating great havoc in the vegetable gardens in and about Sydney, completely eating up the leaves of cabbages and cauliflowers, and rendering the entire crop utterly useless. The caterpillar, a number of which were exhibited, is an active, slightly hairy, green worm; the pupa is also green, and is fastened to the under side of the leaf on which it has fed by a cocoon of beautiful open lace-work. The rapidity with which this insect seems to reproduce itself is most astounding, and accounts for the short work it makes of a bed of cabbages. The insect was, it is said, first noticed last year, and then not in destructive numbers, so that it will probably be found to be an importation."

REMEDIES FOR CABBAGE WORMS.

FROM the thousands of nostrums recommended through the agricultural press, we have chosen only those to which we have given personal attention, and can recommend from experience, and also those recommended on high authority and which common sense will approve.

Hot water.—Every worm visible upon the cabbages may be killed by the use of water at the temperature of 130° Fahrenheit or 55° Centigrade. The water may be boiling hot when put in the watering can, but it will not be too hot when it reaches the cabbage leaves. The thick, fleshy nature of the leaves enables them to withstand considerable heat with very little injury. The sacrifice of a few heads of cabbage will soon teach an experimenter how far he can go with the hot water. It may be sprinkled over the plants from a fine rose watering can or poured on with the sprinkler removed. If it is very hot it will color some of the leaves, but even where the cabbage is considerably scorched it will recover and renew growth from the heart.

The attempt is made sometimes to increase the efficacy of the application of water by dissolving in it or mixing with it various substances, such as salt, saltpeter, alum, copperas, and the like, but the use of these is attended with more danger to the plant, and is unnecessary. Other preparations are made by boiling leaves of the elderberry, smartweed, or other pungent or fetid plants in the water, but the effect of these in killing the worms seems to be no greater than that of the water alone.

Pyrethrum.—Where hot water cannot be applied readily, the most efficacious remedy is the application of cold water with which has been mixed a small quantity of Persian insect powder, or pyrethrum. Two hundred grains of powder may be mixed with 2 gallons of water, or in the proportion by weight of about 1 to 600, and the mixture sprinkled or squirted on the plants. This powder was first used by us against cabbage worms in the summer of 1879, and its efficacy was verified by the independent experiments of several persons made during that and the following years at our request, those of Judge J. F. Bailey, of Marion, Ala., Prof. W. A. Henry, now of the University of Wisconsin, and Prof. A. J. Cook, of the Michigan Agricultural College, being particularly satisfactory. The results of later experiments at Washington are shown in the reports of Messrs. Lacey and Rives, here appended.

The effect of pyrethrum powder dusted upon the white butterflies is not very marked, unless the powder is very thoroughly applied, while a very little affects the larvæ powerfully. In the experiments made by Judge Bailey, dry pyrethrum powder, at the rate of half an ounce to 100 square feet of planted cabbages, entirely destroyed the larvæ or drove them from the plants, and the butterflies ceased to visit the powdered cabbages, and resorted to the turnips and mustard. (*Amer. Entom.*, v. iii., p. 296.)

Kerosene emulsions.—We have advocated strongly for the past three years the use of kerosene emulsified to admit of dilution with water as admitting of very extensive application as an insecticide, and we are satisfied that it will be found of great value in the cabbage field. We omit the details of preparation, but would refer the reader to the last annual report of the Department, pp. 112-116.

Other substances.—Dry applications of lime, salt, pepper, even bran or buckwheat flour, road-dust, soot, or any other powder not deleterious in human food, are often tried with some success and recommended against the *young* worms.

Mr. Quinn, writing in the *American Agriculturist* in November, 1870, says that a compound of lime, superphosphate of lime, and carbolic powder (*i. e.*, sawdust impregnated with carbolic acid), was efficient in destroying cabbage worms.

A writer in New York *Tribune*, 6th July, 1872, give the proportions used as 20 parts of superphosphate of lime, 3 parts of shell or fresh air slaked lime, and 1 part of carbolic powder. This scattered in small quantities upon each head of cabbage at three or four different times drove the cabbage worms from the plants, and the crop was saved, with not more than 5 per cent. of loss.

Either Paris green, London purple, or white hellebore will kill the worms if scattered or sprinkled on the leaves where they will be eaten by the worms, but few persons will use these substances for fear of their poisonous effects.

Cresylic acid and whale oil soaps have been highly recommended. Professor Lazenby, of Cornell University, says that a safe, cheap, and effective remedy is to dissolve 1 pound of whale oil soap in about six gallons of water, and apply it two or three times during the season, or place a few quarts of tar in a barrel of water, and apply the mixture in the same way.

Sprinkling the larvæ with yeast has no effect; salt brine causes the worms to curl up and leave their quarters very suddenly. It does not injure the cabbage in the least, though there are but few plants which will bear such an application.

Preventive measures.—All the remedies, however, are not comparable in excellence with means of prevention, for every application only kills the insects that are on the plant at the time; and as long as the weather continues warm enough to develop them, a succession of new individuals appear upon the plants throughout the season. Experiments with various odors, pungent and repulsive to human sensibilities, emanating from substances placed about the plants, such as musk, camphor, spirits of turpentine, petroleum, asafœtida, etc., were found by Mr. I. B. Taylor (*Rural New-Yorker*, November 2, 1872) to be of no avail. The plants must be covered so as to keep the butterflies from them. Fronds of the common brake fern (*Pteris aquilina*) or branches of elder bushes (*Sambucus*) have been used for this purpose, but Mr. Taylor found on spreading a *white net*, with meshes about two-thirds of an inch in diameter, at a height of about a foot above his cabbage plants, and coming down to the ground on all sides, that although the butterflies alighted in great numbers upon the net they never passed through it, and consequently laid no eggs upon the plants. This net, he says, can be so spread as to be removed easily for hoeing the cabbages.

When the worms are found upon a small patch of cabbages, the surest method of destroying them is to hand pick them and crush them beneath the foot; jarring the plants causes many worms to fall to the ground, where they may be killed.

Poultry, if allowed free range in the cabbage field, will soon clear off the worms of our indigenous species of butterflies or moths, but they are of no avail against the imported rape butterfly, as they will not touch the larvæ or imagos. (*Amer. Entom.*, v. iii., 55.)

By laying pieces of flat board between the cabbage rows, and supporting them at from two or four inches (50 to 100 mm.) above the surface of the ground, the *Pieris* worms, as they come to their full growth, will be induced to suspend themselves from the under side to undergo their transformations, and may then easily be collected and destroyed. This remedy, of course, will only apply to the butterfly pupæ.

The white butterflies being slow and lumbering fliers may easily be caught in a net and killed. A short handle, perhaps four feet long, with a wire hoop and bag net of muslin or mosquito netting, are the only materials needed to make such a net, the total cost of which need not be more than fifty or seventy-five cents.

POISONING DEVICES.

The need of some simple devices for the application of the various substances, both dry and liquid, that are to be used against cabbage worms was obvious, and, after considering such as were already known, it became evident that something better could be devised for powdering or spraying by hand low growing plants of various kinds.

Those here decribed and figured were planned and perfected with the assistance of Dr. Barnard, who was charged with their construction, and who worked out the details according as experience and experiment suggested.

Plate 4, Fig. 1, represents a small bellows, *g*, with handles, *hh*, one of these serving as a discharge spout, communicating at *e* through the powder receptacle, *p*, to its delivery at *s*. The bellows is made mechanically tight without glue or other adhesive, soluble on exposure to wetness, and possesses great power. Taking the discharge from the handle of the bellows renders it of simpler construction and enables the hand supporting the powder can and extension pipe to be close to the can, while the body of the bellows tends to balance the weight of the powder, etc., making the tool more easily wielded than if the weight were more distant from the hand. The form of the can is found to be preferably that of a double cone or double pyramid. At its top is a can screw opening for inserting the powder and closing it securely from wetness. The blast spout passes radially against the inside of the basal cone. The internal relations of the plast to the powder will be better explained by observing Fig. 2, which is a sectional view longitudinally through the parts. The tube, *e r*, inside the can has a slot in its side, or sides, and about midway in its passage is a shut-off device, *j*, where this is set, partially closing the tubular passage; only a part of the blast going through direct, while the rest is crowded out to grind away the powder exposed by the slot passage. The more of the blast thus crowded out, the more of the powder will be fed to, and carried away by, the blast. One, two, or more slots or rows of holes of size and shape to suit may be thus made whereby the blast can act upon the powder in the base of the can.

Other views of the same device, with an extension pipe, having a crooked discharge end, appear in Figs. 4 and 5. The lettering has the foregoing explanation so far at it corresponds; but *j* indicates the upper or movable face of the bellows, *z* a gauze cover over its incurrent calve, *i* is the long extension pipe, with a crook, and *s* its discharge. The long pipe enables the poison to be freed at a safe distance from the operator, and the crook allows it to be easily applied either in an upward or a horizontal direction into the plant.

Other crooks desirable for some purposes are shown in the

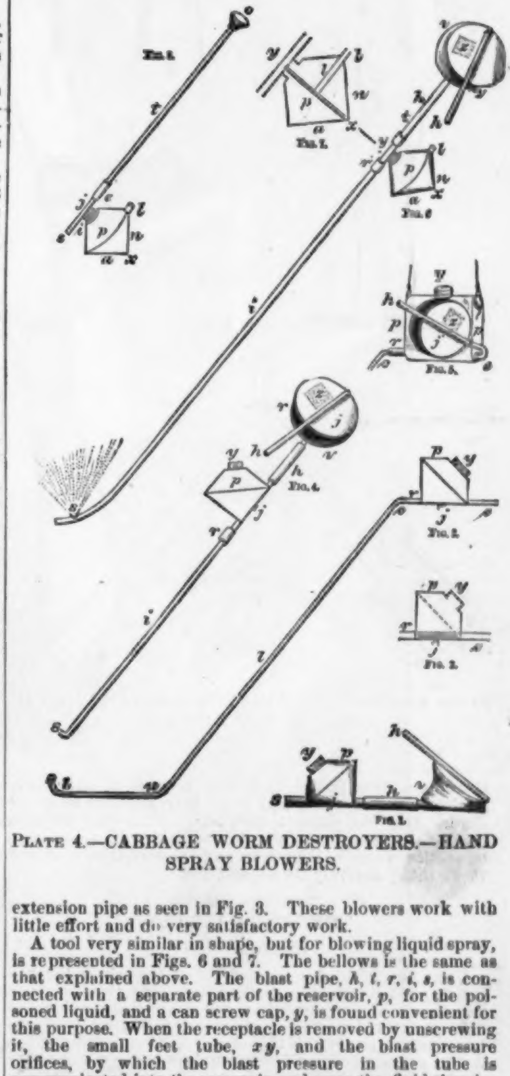


PLATE 4.—CABBAGE WORM DESTROYERS.—HAND SPRAY BLOWERS.

extension pipe as seen in Fig. 3. These blowers work with little effort and do very satisfactory work.

A tool very similar in shape, but for blowing liquid spray, is represented in Figs. 6 and 7. The bellows is the same as that explained above. The blast pipe, *h, t, r, i, s*, is connected with a separate part of the reservoir, *p*, for the poisoned liquid, and a can screw cap, *y*, is found convenient for this purpose. When the receptacle is removed by unscrewing it, the small feet tube, *x y*, and the blast pressure orifices, by which the blast pressure in the tube is communicated into the reservoir and upon the fluid therein, except that which is in the feed tube and to be ejected by said pressure, to squirt liquid through the feed pipe into the blast pipe, are exposed to be of easy access in case of choking of the passages, or if it is desired to readjust their alterable capacity to feed a greater or less quantity of liquid to the blast. The peculiar form of the poison can, *p*, with the feed tube terminating in its basal apex permits a greater range of tilting of the same without interfering with the supply to the feed tube, even if the liquid is low. But the construction is such that the apparatus feeds when inverted or when in any other position, and in all positions the feeding is by virtue of the blast pressure through an inlet from one part of the blast pipe where the pressure is greatest to the interior of the receptacle and upon the liquid therein, to eject it into another part of the blast pipe where the pressure is less.

The small can is at times furnished with an automatic supply of liquid from a larger tight reservoir, carried knapsack fashion upon the back or otherwise, and having an excurrent tube connected with the inlet, *l*, of the smaller receptacle. Such a larger receptacle is represented upon the back of a person in Plate V., Fig. 1. An extension tube, *s*, is shown, and this may terminate in a reatomizing nozzle similar to the nozzles represented in Figs. 2 and 3, or the simpler form here figured, which is made by closing the end of the tube and making a side perforation, *s*, at a short distance back from the end wall. By another mode of con-

* Synonyms.—*Plutella limbipennella* Clem.; *Plutella mollipedella* Clem.; *Cerostoma brassicella* Fitch.

struction the foregoing nozzles are made to discharge the atomized spray in the direction of the main axis of the blast pipe, which is sometimes desirable, as in applying the poison to trees or in directing it horizontally or downward. For these purposes the extension tube may be removed entirely from its juncture, *r*, and with such a short discharge-pipe spray may be thrown immediately therefrom without reatomizing, yet a much finer quality of mist is produced by adding one of the reatomizing nozzles thereto. Again the machine can be used by substituting a person's breathing apparatus for the bellows. In this case, as in Plate IV., Fig. 8, a blow pipe and mouth piece, *o*, should be added, that the mouth may be far from the poison. This is the cheaper form, and may be employed by careful persons. The other parts of Fig. 8 are the same as already explained.

Finally, for similar purposes a small, squirting apparatus, pictured in Plate V., Figs. 1–5, may be described. It consists of a small telescope pump having the internal structure of the stirrer pump elsewere described. The cylinder, *c*, is held by one hand, and the hollow piston rod, *x*, by the other. The piston may be held steady while the cylinder is reciprocated back and forth upon it. Being a double acting pump, a constant pressure and stream is applied. It draws the fluid from a knapsack reservoir, *k*, or other receptacle, through the suction hose, *h*, which is joined to the pump cylinder at *c*. The valve, which occurred in the base of the pump already described, is here inserted in the suction hose, and by means of the hose is held in connection with the pump. Also in this case the fluid is ejected from the tubular piston rod through its extension pipe, *x u*, and the nozzle, *s*, which is the same as those already referred to. The extension pipe may be forked, as in Figs. 4 and 5, to apply two or more jets of spray, or it may be entirely removed when desired. Also the pump is well adapted for extinguishing fires or squirting into trees, etc., while it will supply itself by suction from a bucket or any other suitable source.—*C. V. Riley, Report of the Entomologist.*

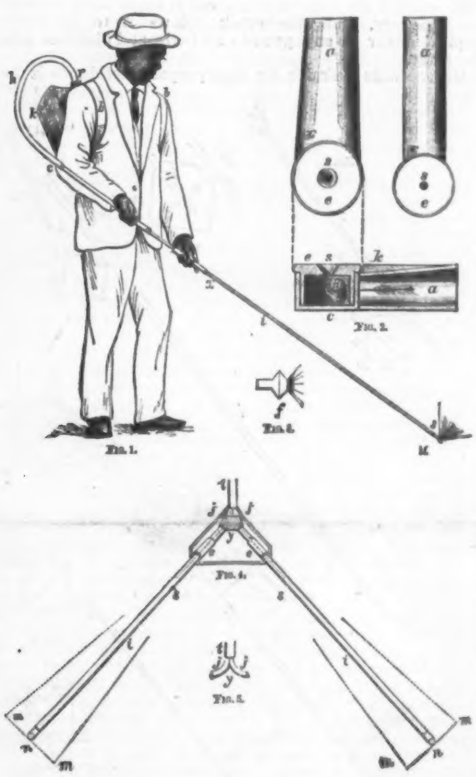


Plate 5.—CABBAGE WORM DESTROYERS.—KNAPSACK SPRAY EJECTOR.

THE ROSE GALL-FLY.

(*Rhodites Rosæ.*)

Very nearly allied to the gall-flies of the oak is the rose gall-fly, which forms the curious moss-like tufts on roses, and more commonly on briers, called bedeguars, which were formerly used in medicine. At present this insect has scarcely earned the unenviable title of a "garden destroyer," as it does not appear in sufficient numbers to cause any appreciable injury to roses. Still, it must always be borne in mind that it is quite possible, and not unlikely, that it may become more numerous, as its relative Cynips Kollari (which forms the marble galls on the oak) did. This insect was very rare in this country until about thirty years ago, when it suddenly appeared in great abundance in Devonshire, and is now common all over England. If the rose gall-fly was to increase as rapidly, it would prove a great annoyance to all rose growers. I therefore recommend all lovers of roses (and who is not?) to destroy these galls whenever they find them. During the summer cutting them off and throwing them on the ground will be quite sufficient to kill the grubs, but later in the season it will be safer to burn them, as if the grubs are full grown it is quite possible they might survive, and become perfect insects. It is certainly a very curious fact that grubs which are so much alike in form and habits should be the cause of galls which vary so much in general appearance. In my article on the gall-flies of the oak in *The Garden* of October 14, I pointed out how very much most galls differed from one another, even those found on the same parts of the tree. The rose gall is no exception to the rule; it is a very singular structure, composed internally of a number of cells packed close together, from whose outer portions spring a quantity of long branched hair-like filaments. Why the gnawing of the grub should cause the tissues of the leaves and stems to assume these strange forms is at present a mystery.

These galls or bedeguars are very pretty objects, of a pale green color, tinged in places with red. When young they are soft, but become quite hard after they leave off growing. The large galls contain a number of cells, but little ones such as are shown on the midrib of the leaf (Fig. 1) contain only one. Within each cell is a maggot. The rose gall-fly, unlike its relative of the oak, produces only one generation in the course of the year, and the fully developed offspring are of both sexes, and resemble their parents in every way. Any one, however, trying to rear the perfect insects from the galls may be surprised at finding two very different-looking insects produced, which may be accounted for by the fact that a small parasitic insect, one of the Chalcididæ (a family very nearly related to the Ichneumonidæ) often punctures the galls and lays its eggs in the gall fly grubs. The grubs from these eggs destroy the original occupants of the gall, undergo their transformations within it, and leave it in the spring, when they are often mistaken for the real gall-flies. They may, however, easily be distinguished from them by their bright metallic coloring.

The gall-flies remain in the galls until the spring, when they emerge, and soon set to work and puncture the stems or leaf-stalks of various roses and briers, depositing an egg in each puncture. As soon as the grubs are hatched they begin to feed, and the growth of the gall commences, it probably does not attain its full size until the flow of sap in the plant comes. These galls vary in size from a small one, containing only one cell, to a ball 2 inches or even 3 inches in diameter, containing a dozen or more cells. The filaments with which these galls are covered are not simple, but are branched or feathery (Fig. 2). The gall-fly (Fig. 4) is about a quarter of an inch long, and measures $\frac{1}{3}$ of an inch across its expanded wings; its head, thorax, and antennæ are black;

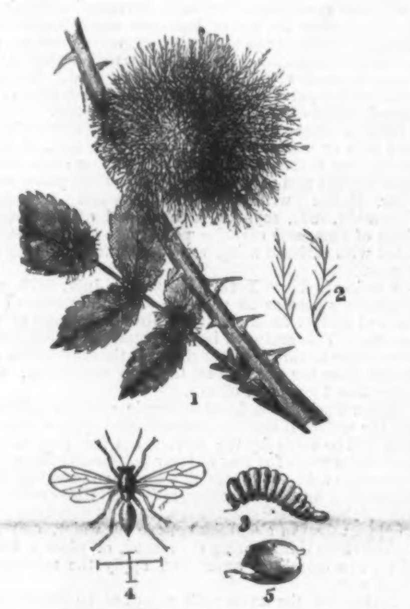


Fig. 1.—Bedeguars on Rose stem and leaf; 2. filaments from ditto; 3. grub of Rose gall-fly; 4. Rose gall-fly; 5. side view of body of ditto.

its legs are long and reddish-yellow in color; its body is smooth, shining, and reddish-yellow toward the base, gradually becoming black toward the apex. On the under side of the body (Fig. 5) is the ovipositor, the internal mechanism of which much resembles that of the oak gall-fly. The grub (Fig. 3) is about $\frac{1}{8}$ of an inch in length, and is smooth and tapering, but the segments are very clearly defined; it is quite white, with the exception of a pair of reddish-brown jaws.—*G. S. S., in The Garden.*

THE GLOWING SUNSETS.

To the Editor of the Scientific American:

I have read everything which has appeared in the Scientific American in relation to the "glowing sunset," with more than ordinary interest, hoping that some one of our prominent scientists would arrive at something like a reasonable conclusion tending to solve the mystery for the public benefit, and to the general satisfaction of all. So far all has been vague and unsatisfactory. Our greatest observers have been entirely non-committal, and there seems to be nothing left for the amateur watcher to do but grope in the dark. I, for one, cannot help looking, and here is what I think I have found.

Starting on the truism that "like causes produce like effects," I assume that the "colored sunsets" were caused solely by an excess of moisture in the upper atmospheric strata. It is by no means an uncommon thing to see in this latitude a single sunset equal in brilliancy to any we have witnessed during the past fall and winter. We knew that one to be the effect of an increase of moisture in the atmosphere; so, given a sufficient cause, and the effect would be any number of such sunsets. Have we had the cause? I think so. The great eruption in Alaska must have been sufficiently powerful to send a vast volume of heat into the upper atmosphere; the upper strata of the atmosphere to a great height must have become abnormally heated; it became filled with moisture to a corresponding degree; a vast surface was covered with this warm, moist atmosphere, much greater than all the volcanic dust of the ages could occupy, and the consequence was, that when the sun reached the proper altitude in the west, so that his rays fell upon the saturated atoms at the proper angle, we saw following each other in rapid succession all the colors of the spectrum until finally it settled down into brilliant red.

Now, this happened just the same every time and in the same order. I now submit whether, if volcanic dust or cosmic particles were capable of bringing about such a result at all, it would not vary from time to time as the great clouds of dust were whirled to and fro by the changing currents of the upper air? Is it not fair to suppose that some celestial cyclone would have blown that dust about in such a manner as would have seriously disturbed the order of things as usually set forth in our evening exhibitions? Now, if my theory be true, what would we naturally look for? A much greater precipitation, of course. Have we had it? When has there been so great a snowfall and rainfall combined as during this winter so far? I wrote the substance of this for a local paper some two months ago, and stated that there would be a greater precipitation than ever known before, and that, just in proportion as the precipitation took place, the brilliant sunsets would cease. Both the predictions have been fulfilled; neither could have been unless the first cause was an excess of atmospheric moisture superinduced by an abnormal amount of heat; then all the conditions are perfect. Given the heat, then comes moisture, then glowing sunsets; then comes contact with cooler currents of air; precipitation—rain, hail, snow—follows. More and more moisture leaves the air, and less and less brilliant become the gorgeous glows in the west.

Mr. Editor, I am no scientist, only a thinker; and yet it does seem to me that the solution is to be found in this direction.

J. H. D.

Cape Vincent, N. Y., Feb. 24, 1884.

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